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Weaving and Finishing NYLON FABRICS*

P. D. ATWOOD
Nylon Division, E. I. du Pont de Nemours & Co., Inc.

THIS is the second invitation extended by your group to the Nylon Division of the du Pont Company to appear before you. We greatly appreciate this opportunity to discuss in greater detail some of the technical aspects of subjects previously presented in a more general vein. Experience gained by the trade, as well as our own technicians, in the interim, has provided additional information and confirmed original theories and tests. I would like to explain at the outset that I am not posing as an authority on weaving or finishing. My remarks are based on facts which we have developed, coupled with substantiating practical information gained by the trade and openly discussed by them in the interest of furthering the war effort.

"Weaving and Finishing Nylon Fabrics" is the subject chosen for presentation with emphasis on the value to be gained from a better mutual understanding, between weaver and finisher, of the characteristics of nylon yarn as related to their processes. We have had ample demonstration of the value of such an approach during our efforts to help solve some of the fabric problems arising out of the war

We also have had an excellent indication of what can be accomplished by an exchange of ideas between weaver and finisher. This has been demonstrated by the constructive work of the joint "Weavers and Finishers Nylon Technical Committee," originally sponsored by the Air Corps and so very ably fostered by the National Federation of Textiles. Anything your group can do, either individually or collectively, to reach a better understanding of the characteristics of nylon should certainly pay handsome dividends in producing a better final product giving maximum consumer satisfaction.

We feel that there are three major basic properties of the present nylon yarn which probably exert a greater amount of influence on the final fabric construction, weaving performance and finishing operation than any of the other properties. They are elasticity, inherent shrinkage, and the ability of the fiber to take a "set." You will, undoubtedly, agree that this latter property alone; namely, ability to take a "set," presents opportunities and at the same time technical considerations entirely foreign to the usual finishing concepts as applied to the other commonly-used textile fibers. Better joint understanding of this factor alone will justify any effort at cooperation expended by weavers and finishers.

There are two minor properties of nylon; namely, low moisture content and individual filament strength, which I will touch on later.

In order to clarify the significance of these three major properties, it is necessary to offer a brief explanation of how or why the yarn possesses these characteristics. Our yarns are spun at a denier approximately four times the denier size desired in the final yarn. Following the spinning operation, the undrawn thread with an internal molecular structure piled into a miscellaneous arrangement like straws in a haystack is subjected to a drawing or stretching operation. The mechanics of this operation are relatively simple, employing a drawing action between two rolls operating at different predetermined speeds. The difference in controlled speed between these rolls establishes the draw ratio which is about 4 to 1.

In this drawing process, the molecules are oriented or rearranged in orderly parallel relation to each other. This results in a thread possessing high tensile strength, true elasticity and leaves the thread with a fixed amount of inherent shrinkage. Because of the internal forces which impart elasticity and shrinkage, the thread at this stage is tending to relax or contract. It will continue to exert this tendency when it is subjected to conditions which permit it to relax, such as rewinding at minimum tension from one package to another or until you deliberately introduce conditions such as boiling in skein form, which induces a high degree of relaxation and shrinkage. Although such treatment can remove all of the inherent shrinkage, the yarn will still possess true elasticity. Further clarification of the internal reaction during shrinkage can be more logically covered when we come to the discussion of "setting."

The take-up package or drawtwister bobbin containing about one pound of this highly oriented nylon is our simplest and most direct form of delivery package to the weaver, knitter or other processor.

Let us now deal with each of these properties, presenting a current consensus of how they can influence the finished fabric and why it is advantageous for the processor of nylon to understand their influence.

When stretched for 100 seconds against no load, nylon yarn possesses about 8 per cent true elasticity showing 100 per cent recovery within 60 seconds. Although it is far superior in this respect to all other commonly-used textile fibers, it does not show the instantaneous snap-back of a rubber band. If nylon yarn has been held under tension for several days at 72 per cent relative humidity and then is allowed to relax against no load, it recovers approximately 50 per cent of the stretch almost instantly and about 85 per cent in the first 24 hours. The remainder of the recovery back to its original length will require about two weeks' time. From a yarn processing and weaving standpoint, the importance of a true understanding of this property is obvious. Disregard of this property will make it more difficult to avoid variations which can otherwise be introduced during the preparatory and weaving steps. Process control will be more positive if the thrower or weaver uses absolute minimum tensions and controls the uniformity of each position as though he were dealing with a "rubber" thread. Warp streaks, quilling barre, and non-uniform selvedge tension are typical conditions which can be created by disregard of this basic property of elasticity.

From your standpoint as finishers, you can benefit in two ways by proper understanding of elasticity. First, you can review your tension controls to insure best possible uniformity and least distortion of the fabric. Secondly, you will be able to more intelligently interpret any variations in final fabric appearance which may be traceable to yarn preparatory or weaving variables.

Without this property of true elasticity, no yarn is fundamentally suitable for ladies' hosiery and possibly other knitted fabric applications. A yarn with this property can be used to definite advantage in imparting distinctive characteristics to woven fabrics.

Residual shrinkage on the drawtwister delivery bobbin, previously mentioned, will range from about 8 to 11 per cent depending on denier, tenacity and other controlled factors in our process. The weaver does not use this yarn direct from this package except for certain constructions requiring low twist filling yarn. In most of his applications, both warp and filling, there will be additional twist added, up to

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say 5 to 10 turns, and usually with the application of size and oil.

The best known sizing material for nylon, at this time, is a water soluble polyvinyl alcohol known as PM-90 size. The application of this material, either by single-end sizing methods or by slasher sizing, causes the yarn to shrink. This is normally the first point at which conditions are deliberately introduced that induce appreciable relaxation and shrinkage. Single-end sized yarn in general will retain a residual shrinkage of about 5 to 6 per cent, and slasher sized yarn probably much lower. Slasher sizing is in the preliminary stages of development, and neither we nor the trade have as yet developed adequate technical data on this process.

The weaver then will be dealing with an easily stretched yarn possessing true elasticity and containing about 5 to 6 per cent residual shrinkage. This shrinkage factor will again exert its influence when the fabric is wet out in the first finishing steps or under the influence of high temperature dry heat. The significance of this reaction and its relation to finishing will be brought out later under the discussion on "setting."

This shrinkage affects the fabric construction and must be taken into consideration in the original construction calculations, as well as in your finishing procedures. Here again, it is obvious that nonuniform tensions in twisting, sizing, warping, quilling and throughout all processing steps can aggravate any degree of shrinkage variation inherent to the original yarn. This imposes on each preparatory step the need for control of low and uniform tensions, as well as control in steps involving aqueous size solutions or any other operation in which shrinkage is induced.

Although the basic properties of the yarn originally indicated to us the importance of the control of shrinkage and elasticity factors, and prewar small-scale weaving experiments substantiated our theories, it remained for the parachute program to bring out the full impact of their influence. We believe most of the experienced weavers and finishers of nylon war fabrics would agree that they, as well as we of the Nylon Division, have just learned enough thus far to make us all properly respect the influence of these factors. We cannot overstress the desirability of close process control by the throwster, weaver and finisher.

To further illustrate the value of this close control, we can cite the dangers arising from a mixing of yarns from different throwing sources which may contain an appreciable difference in residual shrinkage. The weaver quite frequently uses two or more throwing and sizing sources, and this difference could be easily and in all good faith introduced into a fabric by the mixing of twistset and non-twistset yarns.

Twists up to, say, seven turns in a 40 or 70 denier yarn do not, in our opinion, require steam setting to relieve liveliness of twist. However, some throwsters may deem it a necessary part of their particular methods of processing to use twistsetting. The use, therefore, of a twistset yarn with residual shrinkage in the range of 4 per cent alongside of non-twistset yarn from another throwster containing about 6 per cent shrinkage will certainly result in warp streaks, filling width variables from quill to quill, puckering and in general a worthless piece of fabric. If, on the other hand, yarns of different shrinkage characteristics are deliberately introduced into the fabric construction, some novel and useful results can be obtained.

As finishers, you can benefit in at least four ways by a better understanding of shrinkage as follows:

(1) You can arrange your equipment and procedures in a more logical manner, particularly with regard to the interrelation of setting and shrinkage.

(2) Experimental work, either theoretical or practical, can be outlined with greater assurance of improved methods if you understand how the fiber will react.

(3) It is vital for you to know what type yarns a weaver is using in order to more effectively bring out the final properties or appearance he is seeking.

(4) As in the case of elasticity, you will be in a better position to deal with defects or variations which may occur and more rapidly introduce corrective measures wherever such may be necessary in either weaving or finishing.

Before we deal with the third and probably most important characteristic of nylon; namely, its ability to take a set, we want to mention two minor but interesting points—the moisture regain and individual filament strength.

Since the moisture regain of nylon is considerably lower than that of the other textile fibers, such as rayons, cotton or silk, the control of static is desirable but is no more complex than with acetate rayon. If proper control of humidity, at say 60 to 70 per cent, plus other mechanical aids do not permit the weaver and finisher to operate at speeds they desire due to excess static, then anti-static materials can be brought into the picture. This low moisture regain provides nylon with one of its most appealing properties from a consumer standpoint; namely, the quick drying characteristic.

Because of its high tenacity, the strength of the individual filaments which comprise a given denier of nylon is necessarily higher than the filament strengths of the standard tenacity acetate or viscose process rayons. This individual filament strength presents a problem on the loom when entangled warp ends approach reeds and heddles. Refusal of filaments to break apart causes malfunctions which can result in floats and other weaving complications unless carefully guarded against. Further developments along the line of finer denier per filament nylon yarn will undoubtedly minimize the filament strength effect and result in an even better weaving yarn than is now available. We believe that any synthetic high strength yarn will follow a similar pattern of relationship between filament strength and weavability. This characteristic places a responsibility on the producer, throwster and weaver to maintain best possible control over their equipment surfaces and methods so that a minimum of broken filaments will result.

We feel we are safe in stating that the overall weaving performance of nylon in the fabric weights and construction produced for the armed forces is excellent from a loom efficiency standpoint. Efficiencies have ranged around 95 per cent in fabric weights ranging from 0.75 ounces per square yard to 19 ounces, with fabric constructions involving twills, taffetas, lenos and several variations of these basic types. Deniers of our yarns utilized for this work have ranged from 20 to 240 denier, with many additional plied yarn items. This experience indicates the versatility of the product in the weaving field.

Because of your interest in the subject, I will touch on the current picture in the dyeing of nylon. You are all familiar with the acknowledged superiority of acetate-type dyes from a uniformity standpoint. We have no new or additional information to offer at this time that changes this picture. We can say, however, that the results of work now being conducted on military fabrics point to the probability of improved methods of dye application on nylon permitting a wider range of suitable colors in acetate, acid, chrome and possibly other types. New concepts in equipment will probably come out of this experimental work.

Setting can produce such beneficial results, and because the theory and practice at least partially influences all other steps in finishing, I will now go into this subject in detail.

A finisher of nylon fabric must bear in mind the unusual property of nylon to take on a more or less permanent set when subjected to heat, moisture and time. Setting is a relative term and can be applied to a wide range of conditions. We do not

consider a nylon fabric to bet set unless it has been subjected to a minimum of five minutes in boiling water, and this implies that the surface temperature of the fabric is continually at the boil. Higher temperatures under saturated moisture conditions will give a better and more permanent set and require less time.

What happens when you set nylon yarn and why does the fiber react to heat, moisture and time? At this time, the most plausible explanation of this phenomena is one of readjustment or realignment to a state of less strain on the part of the molecular structure which forms nylon.

The drawing operation previously outlined results in aligning or straightening out the molecules in a rather orderly parallel arrangement. However, these molecules in assuming their places in this arrangement may be put under some stress. In addition, the unavoidable stresses introduced in the twisting, warping and weaving unquestionably exert their own influence. We do not actually know whether these are additive or minimizing effects. Some relaxation and a partial degree of shrinkage have usually already taken place before you receive the fabric, as explained before in my remarks on elasticity and shrinkage. The further relaxation of these stresses and readjustment to a more "comfortable" position with respect to adjacent molecules results in the structure of the fiber wanting to remain in this new alignment or to remain set. Inherent shrinkage is reduced to a fraction of the original value when the fabric is in relaxed state during setting. We have not worked out in a practical way what properties are imparted to a woven fabric which might be held in a rigid or fixed position without any accompanying shrinkage during setting. We know, of course, that highly desirable properties are imparted to knitted hosiery fabric that is set on a rigid form and does not necessarily undergo a complete shrinkage past a certain point.

Usually setting is accomplished by subjecting the fabric to boiling water or steam under pressure. A certain degree of setting is obtained with dry heat at elevated temperatures, but this effect may be less permanent than with steam. Work is now going on to compare the effect of steam-set versus dry heat-set fabrics.

The set which a fabric has taken in boiling water or steam will not be disturbed until the time and temperature of the original setting conditions are exceeded. In other words, fabric set in boiling water will have to be subjected to pressure steam with temperatures of, say, 215° to 225° F. in order to undo the set accomplished at 212° F. Time is also an important factor.

The fact that nylon is subject to setting must be taken into consideration when boiling off or scouring the fabric. An unset fabric must not be allowed to wrinkle during the boil-off because the wrinkles will be permanently set unless they are removed by subsequent and more drastic setting procedure.

Another point requiring clarification is the concept that setting of a fabric will absolutely "freeze" or prevent subsequent minor dimensional change. The evidence thus far indicates that steam setting does not accomplish this. On the contrary, a properly set fabric containing a minimum of shrinkage in the range of about 1 per cent will show some change under the influence of variations in moisture content. When we speak of dimensional change being possible in a set fabric, we are talking about a minor change of a magnitude that will not affect the ability of a fabric to be processed into a garment with excellent and lasting fitting properties. This fit, or major dimensional stability, will be retained after laundering or other normal abuses that the consumer will expect a satisfactory fabric to undergo. The real benefits from setting are, therefore, of a stabilizing nature, insuring a maximum degree of freedom from wrinkles and other distortions accompanying the use and laundering of the fabric.

Every manufacturer using nylon should study the setting of his product from two angles:

(1) What setting will do to improve the efficiency of his manufacturing operations.

(2) What setting can do to insure a more satisfactory finished product from a consumer standpoint.

As illustrations of the need for the above suggested study, the following incident will show the benefits which can accrue from an understanding of the practical aspects of this setting phenomena. This particular concern was thoroughly grounded in the value of setting nylon hose, but did not project their knowledge into a venture in nylon tricot. Only partial success was attained in fabricating an article from an unset all-nylon warp knit fabric due to curling of the fabric edges with attendant cutting and sewing difficulties. Gloves made from this unset fabric did not retain their size after wearing and washing, resulting in consumer dissatisfaction; but when the fabric was set in a pressure chamber in roll form, the curling tendency was eliminated, cutting and sewing efficiency markedly increased and a very satisfactory product was obtained, one that retained its size and shape regardless of repeated washings. Unset woven fabrics gave a similar reaction in another article of wearing apparel.

At least brief reference should be made to the influence of dry heat finishing. Before the war we were experimenting with a new method of finishing nylon fabrics, but did not at that time and have not since, had an opportunity to fully develop it on a commercial scale. This method of finishing has been termed "heat finishing" and involves subjecting the nylon to high temperature dry heat for a few seconds. In actual practice we have employed temperatures of 425° to 435° F. and a time of approximately ten seconds. The results have been quite different from those obtained by the use of steam setting. The principal benefits to the fabric have been an improvement in softness or hand, which is also accompanied by better draping qualities and improved resilience in the fabric. Subjecting a nylon fabric to this kind of heat finishing treatment also results in greater shrinkage widthwise.

Up to the present time, fabrics treated in this manner have been subjected to the necessary temperature by passing the fabric over a specially designed hot roller. We proved out the theory and pilot application of heat finishing on an experimental machine, and we will be glad to discuss the design details with anyone desiring to duplicate the machine or further develop it on a commercial scale. Recent experiments, however, indicate that similar results may be obtained by heated air. The control of temperature is of the utmost importance, since temperatures in this range are necessary to obtain the desired effects. Lack of control at this temperature might seriously endanger the fabric as it is not far below the fusing point of nylon.

It seems likely that such a method of finishing might be developed on a practical scale and be more adaptable to commercial finishing of certain types of fabrics than steam setting. The advantages over the steam method are improvement in hand, drape and resilience. If heat finishing is applied prior to dyeing, it seems to be more effective, since it apparently sets the fabric sufficiently and may allow more flexibility in dyeing methods.

In closing I would like to leave with you my conviction that nylon yarn is a wonderful fiber from which beautiful fabrics and articles of superior properties can be easily produced. Its strength, elasticity, ability to take a set, quick drying, high abrasion resistance and uniformity are all outstanding. Some of these properties are either not present at all in other fibers, or are not present to a degree that offers the user such great possibilities of capitalizing on their existence in the fiber. In the interest of stimulating your thoughts so that you can make the best possible use of this fiber, I have offered these technical comments.

Recent Developments in SYNTHETIC FIBERS and Their Use in Fabrics of the Future*

RENE BOUVET
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IT GIVES me, indeeed, great pleasure to have the opportunity to come before your organization this evening to discuss, in part, the subject of recent developments in synthetic fibers and their use in fabrics of the future.

Formulation of an answer to this question is challenging; difficult to chart, because of many unknowns, in fact, so complex that one can not attempt to present any more than a sketchy outline.

It has been our good fortune to live in a period during which science and engineering have produced splendid synthetic fibers. Some of them are so widely accepted that they have become necessary to the American way of life. In spite of their youth they have achieved startling results, utilitarian and otherwise. From a long range standpoint they hold fascinating prospects.

Their progress and development has been accelerated by the war effort and their effective applications in the war program offer a subject replete with highlights, most ably developed in recent papers presented at the Atlantic City meeting of October 14th of your national organization.

For this evening, may I confine my remarks to the postwar era and the influence of new synthetic fibers on fabrics for civilian uses.

There exists an intense desire to discuss what the fabric trend will be when the world returns to peace and some of the new fibers become available. From expressions gleaned here and there, it becomes clear that all textile branches will give some kind of peace priority to the application of the ever growing group of synthetic fibers whether new or old. During the past war years an atmosphere vibrant with expectancy has come into being. As soon as conditions permit, considerable efforts will be made by all, to place at the service of mankind the higher standards of beauty, comfort and utility afforded by science's latest developments.

It might be well to bear in mind that no sudden large scale production is to be expected as hostilities cease. Some of the already established, but improved types, will no doubt become available in large quantities; however, a period of "trickle production" is unavoidable for a few, requiring either machinery conversion or new equipment.

There is today a rather imposing group of successful fibers to choose from: viscose rayon, acetate rayon, cupra ammonium, nylon, Vinyon, Aralac, etc. Those better known because of their wide applications and of the tremendous quantity in which they are being manufactured are of the cellulosic type; namely, viscose rayon and acetate rayon.

To make it possible to discuss this group in a rational manner, I shall divide them in two classes—the continuous filament and the staple fiber type.

CONTINUOUS FILAMENT TYPE

The modern housewife encounters rayon possibly more frequently than any other fiber. If a list were made of the fabrics embodying either or both continuous filament viscose or acetate rayon, it would be a surprisingly long one, for rayon fabrics have become widely accepted because of their excellent properties, their utility and luxury. They are now so well established that they are constructed according to trade approved specifications. To illustrate past achievements I have here a few samples representing well known types such as taffeta, ninon, canton crepe, sharkskin, twill lining and alpaca.

The question now is, in what way will recently developed fibers affect the fabrics of tomorrow? The general answer is, that continuous and gradual changes are likely to take place. The direction of such changes to be governed by the consumer's desires. Since rayon is tailor made, cast to answer specific purposes, it is possible to be guided by the wishes of the consumers. Modern living sets the goal; chemists, engineers and technicians endeavor to reach it.

As chemists explore deeper the very core of Cellulose, they find that its strength can be controlled. While 2 grams per denier was a fair strength for rayon in pre-war days, large amounts are being currently spun with 3.5 grams per denier. Some in much lesser amounts are being produced with strength reaching as high as 6 grams per denier. Its extensibility can be made to vary. The fiber cross-section may be so affected as to be round, indented or ribbon like. It may be cast like a solid rod, or hollowed, either straight or wavy. Fibers can be spun so fine as to outstrip any immediate need.

As can be seen, research has widened the entire range of synthetic fiber properties, and modern yarns are superior to their predecessors in many respects, the principals being strength, softness, durability and versatility.

What are designers of fabric going to do with the new yarns? A definite longing has manifested itself for light-weight, airy, delicate-looking, yet strong fabrics—those fabrics to be decidedly feminine in type and to be used in a generous amount in the make-up of garments. The fulfilment of such desire is probably first in the list of the stylists and is rendered possible because of having reached new heights in strength, fineness, and softness.

It means the invasion of fields where silk had a chance to survive. But with 40 or 30 denier continuous filament rayon, having a strength equal if not greater, filaments as fine or even finer than silk, no mass return of what has been known for centuries as the "Queen of Fibers" can be visualized.

May I present a few samples, forerunners of the fabrics of tomorrow.

Something not quite as radically different, nevertheless of real value, will be had in reproducing pre-war fabrics with modern yarns, thereby gaining additional and more desirable properties.

Then, there is a tough and coarse viscose rayon yarn, now entirely used to make tire cord fabric for the armed forces. To date, it has had no civilian life and is therefore not generally known. However, it may well be imagined that its outstanding toughness and flexibility can be harnassed in many ways for industrial purposes, conveyor belts, ducks, as base for coated goods, house furnishings and utility fabrics. A few specimens along this line are being presented here.

Finally, there are some fabrics which have been kept out of the market so long for various reasons that they will almost look new when they are revived. I have in mind those of the sharkskin family, the disappearance of which has been due to

* Presented at meeting, New York Section, November 17, 1944.

the shortage in coarse size acetate.

RAYON STAPLE FIBER

The future of fabrics made of staple fibers is influenced not only by the factors touched upon in the forepart of this discussion, but also by the inexhaustible variations offered by blending.

A blend is to the textile industry what an alloy is in metallurgy. In both instances, two or more components are combined into one, in accordance with a finely drawn prescription. The properties of the finished products are thus delicately controlled and may be changed as desired in using different components, in varying their numbers and their relation as to per cent.

The advent of a new staple fiber therefore, means countless additional possibilities, because it can not only be used by itself, but also blended with any or all of a host of natural or synthetic fibers such as wool, cotton, flax, animal hair, acetate, nylon, Vinyon, Aralac, resin fibers, etc.

Technicians and designers are fully aware of the potentialities held out by blending, and are ready to translate into concrete form an accumulation of novel ideas, the realization of which is held in abeyance while industry is engaged in the war program.

When considering the future of continuous filament, the main factors taken into consideration are chemical nature, strength extensibility, cross-section shape, filament size and surface interests. When dealing with staple fiber, another factor of considerable importance comes in; namely, that of staple length. It is important because it controls the type of machinery on which staple can be processed.

The four leading spinning systems are generally referred to as cotton, worsted, woolen, and spun silk. Each has definite limitations as to the staple lengths within which it can operate.

The cotton system was originally conceived for short staples, up to 2". Some modern equipment now accept up to 3". Its flexibility is gradually enlarged and the trend is decidedly toward longer length. Present equipment already permits to sustain widely different trends and fabrics of the future will branch out in many directions.

The very recent development of the 1.0 denier high strength staple make it possible to produce new fabrics of great interest, light in weight, strong, soft and silky—desirable for blouses, handkerchiefs, men's shirts, etc. Here is a sample made exclusively of 1.0 denier, 1-9/16". It speaks for itself.

The high strength of the 1.0 denier staple not only raises the spinnability to new heights, but also allows the introduction of lower strength staple fibers, possessing desirable characteristics such as wool or acetate. The strength of the blend thus obtained is still excellent in yarn as fine as 60/1. Fabrics constructed with such fine yarn, plied, have an unquestionable appeal as women's wear as indicated by these samples.

Then, there is another trend directed toward light weight tropical worsted. In this case, the rayon staple fiber is somewhat coarser and either used by itself or in rayon and wool blend. These three samples cover the point just made.

Using coarser and longer staples, such as 3.0 denier, 2½", a men's wear fabric can be produced of which the crispness, appearance and utility are such as to create a real challenge to cloths made heretofore on the worsted system. I have for examination some specimens of such suitings produced on the cotton system with wool and rayon blends.

When speaking of men's wear, one generally thinks of the worsted trade, also in terms of wool. During the last few years, staple fibers designed to suit the present worsted machinery have made notable progress in rayon and wool blends. It is quite natural that the introduction of synthetic fibers, in a field where a splendid fiber like wool has ruled for many years, can be only gradual and deliberate. Points are being raised as to the lowering of crease retention, also, some noticeable change as to the crispness of the handle; but, what about the advantages of strength, cleanliness, uniformity of product, inroads by fabrics made on the cotton system, and last, but not least, attractive prices? These are powerful factors, becoming more irresistible as new wonders emerge from the scientist's test tube.

Most gratifying progress has already been made in the worsted industry and you will not wonder why after examining a few of these samples, all made on the Bradford system with blends comprising 50 per cent rayon to 50 per cent wool.

Recent synthetic fibers also find a fertile field in woolen fabrics. The woolen system lends itself admirably to their adoption. This group of samples made on the woolen system constitute a concrete example of the trail being blazed by new fibers in the woolen line.

Carpets and rugs of the post-war period also are expected to contain synthetic. The inducement for their use is found in price attractiveness, resistance to fluffing and shedding, immunity to moth and other pests. This is not all, however, for carpet manufacturers have had to contract and pay for their carpet wools months ahead of the time when such wools go into process. This means the immobilization of a large capital. With synthetic fiber procurable in the domestic market, commitments need not extend more than a few weeks, with the result that sizable economy ensues.

Of course, we all know that a great many blankets are already being made with a large percentage of rayon staple fiber in their composition. All indications are to the effect that this tendency will continue to grow as it becomes better understood that warmth retention is primarily controlled by the amount and fine partitioning of dead air space within the fabric.

At this time, I would like to touch upon the part played by dyers and finishers. As one who lived with rayon for nearly three decades I have come to regard rayon as something almost human. Upon being strained, rayon yields, but crawls into a hard shell—when placed under desirable conditions, it readjusts itself, becomes normal again. Treated with consideration, it performs admirably — when abused, it turns out to be disappointing.

Rayon has two great enemies—excessive tension and over-handling. Their control within reasonable limits belongs to the list of musts and the decided trend toward lighter weight fabrics renders it more imperative than ever that further control be given continued attention.

Machine builders have devoted much time to this problem during the last few years. Enlightened dyers and finishers have turned to the use of new and better equipment, handling the cloth under minimum tension and maintaining a most gratifying control as to time, temperature, and tension during all stages of the process.

The importance of the damaging influence of excessive tension can not be overstressed. Fabrics dyed and finished under carefully controlled conditions, with the least possible handling, not only look better, but also assure longer wear and superior hand.

It is interesting to note that the influence of rayon and synthetics has been wholesome for all fibers, including those of natural growth. It has led to the adoption of machines and processes so superior as to design and understanding that natural fiber fabrics processed with them are measurably better than when handled on old-fashioned equipment.

Considerable strides have been made as regards fastness of color, resistance to gas fading, to perspiration, to commercial laundering, to creasing and instability.

The last two are looming as singularly important. The use of resin as practiced in the T.B.L. treatment, though in its early stage in the U.S.A., has accomplished astonishing results. I have here a few British utility fabrics made of 100 per cent spun rayon and simply marvelous with regard to crease resistance and stability.

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Potentialities of FIBERGLAS TEXTILES*

GAMES SLAYTER

Vice President in Charge of Research and Development, Owens-Corning Fiberglas Corporation

WHEN it was suggested that I appear on your program this evening and talk about the potentialities of Fiberglas textiles, my first reaction was that I had better regretfully decline the invitation. Although you and we are in the same business, up to now we have always lived on opposite sides of the tracks. I knew I was not familiar with your side of the business, and I wasn't sure you would be interested in mine.

My being here is sufficient evidence that I changed my mind. Perhaps I should have stuck to my original resolution, but on thinking it over I finally decided you would bear with me if I admitted right at the start that I have come in the hope that I will learn more from you than you will learn from me. In reviewing the development of Fiberglas textiles, and giving you a picture of the situation as it exists today, I hope I will stimulate your thinking to the point where I will be able to obtain from you ideas that will contribute to their continued development.

As many of you know, more than half a century ago glass technicians began to devote serious attention to the attempt to produce glass fibers sufficiently pliable to be woven into fabrics. In 1893 Edward D. Libbey, of the Libbey Glass Company, succeeded in drawing relatively coarse fibers from the heated ends of glass rods. Using the glass fibers as the warp and silk threads as the fill, lampshades were made which were shown at the Columbian Exposition in Chicago.

There a celebrated actress saw them and arranged to have a dress made of the same material. Great crowds flocked to see her in her glass dress. Many went away disappointed, for they had come believing the dress would be transparent. This was not the only disappointment. The fabric was not an all-glass fabric, and it was too stiff to be creased or folded. A fabric could not be woven with the glass fibers alone. The result of Mr. Libbey's experiment was spectacular, and it attracted a great deal of attention, but it proved to be of no practical value.

Years of further research and the expenditure of many millions of dollars were required to develop methods for producing glass fibers that would meet the requirements for a useful textile material. When, in 1936, what is now Owens-Corning Fiberglas Corporation finally succeeded in producing serviceable all-glass textiles, the methods employed differed radically from the crude process used by Mr. Libbey in the 1890's. These 1936 methods, with improvements that have made it possible to produce steadily finer, stronger and more pliable glass fibers, are basically the same as those now employed to produce all Fiberglas textiles.

Glass textile fibers are formed either by high-speed drawing or the yanking action of high-pressure steam. Continuous filament textile fibers are produced by gathering together 100 or more filaments of glass as they emerge from as many tiny holes in the base of a melting chamber, and winding the strand on a winder revolving at high speed. Because the winder revolves much more rapidly than the filaments flow from the melting chamber, the filaments are attenuated to a fraction of the diameter of the holes through which they emerge.

Staple textile fibers are formed by the action of jets of high pressure steam as they strike thin streams of glass emerging from holes in the melting chamber. The steam literally yanks the glass into fibers varying in length from 8 to 15 inches. The fibers are driven down onto a revolving drum on which they form a veil resembling a cobweb. The gossamer web of fibers is wound on a tube in the form of a soft strand.

Glass fibers are subject to an unusually high degree of scientific control. For instance, the glass batches from which they are formed are made up in accordance with formulae adapted to the end uses of the fibers. Fiber diameters are subject to control by regulating melting temperatures and viscosity of the glass, and by adjusting the size of the orifices through which glass flows from the melting chambers.

As a result of this scientific control the fibers possess truly remarkable physical and chemical stability. It is this high stability that is largely responsible for the numerous current uses of Fiberglas textiles, and for the interest some members of the textile industry are showing in exploring possible additional uses, both of the glass fibers alone and in combination with other fibers.

Like most materials that are produced in accordance with exact specifications, Fiberglas textile fibers require handling that meets certain pre-determined requirements. This does not mean that the fibers have to be coddled. They are a sturdy material, and can be twisted, plied and woven on standard textile machinery that has been adapted to handle glass fibers.

Tensile strength of standard Fiberglas textile fibers is in the order of 300,000 pounds per square inch. Average fiber diameters range from 22 to 38 one-hundred-thousandths of an inch. Experimental fibers have been produced with diameters ranging down to 2 one-hundred-thousandths of an inch, and with tensile strength as high as 3,500,000 pounds per square inch.

The fibers are completely incombustible and possess high dimensional stability. At tension approaching breaking strength they show an elongation up to 3 per cent. They are non-hygroscopic and non-absorbent. Moisture absorption is less than one-tenth of one per cent by weight. The fibers do not swell, stretch or shrink under the influence of moisture changes.

Realizable strength, after the fibers have been fabricated into yarns and fabrics, is inevitably less than the strength of the individual fibers, and is influenced by construction of the yarn and weave of the fabric. The breaking strength of Fiberglas yarns and fabrics, however, is considerably higher than that of other textile materials of comparable thickness and construction.

Dimensional stability of the glass fibers is retained in yarns and fabrics. Like the fibers, the yarns show an elongation up to 3 per cent at maximum tension. Fabrics have little or no stretch, except that due to the weave. Moisture changes do not cause stretch or shrinkage.

Both yarns and fabrics have good electrical insulating characteristics. They are resistant to mildew and rot. Moths cannot eat them. They are unaffected by weak alkalis, and by acids in their most concentrated forms, except hydrofluoric and phosphoric acids.

Here, then, we have a textile material with a number of highly desirable properties rarely found to the same degree, or at all, in other textiles. What can we do with this material? So far as the industrial field is concerned, we believe we have

* Presented at meeting, New York Section, November 17, 1944.

many of the answers. Our material is proving its serviceability in scores of forms and applications. But we also believe that there remains plenty of territory for us to explore—that there are many additional industrial uses to which our material can, and will be, adapted.

Fiberglas tapes, braids, cloths and sleevings, impregnated with a suitable varnish, are widely used as electrical insulation in motors, generators, transformers and other electrical units. Because Fiberglas electrical insulation occupies little space and is resistant to high temperatures, it has proved a major aid to electrical design engineers in their efforts to reduce the size and weight of electrical units required to do a given job.

Within recent years, design engineers, using Fiberglas insulation, have been able to reduce the weight of 10-horsepower motors by as much as 170 pounds. For special war uses, Fiberglas-insulated motors are being made that weigh only a pound per horsepower. One of the smallest but most vital motors in a plane is the pitch-change motor which changes the pitch of propellers that have gone dead, so that the blades are turned edgewise to the wind. These motors are insulated with Fiberglas.

The chemical industry uses Fiberglas fabrics to filter hot, concentrated acid solutions. Fiberglas tapes and cloths are employed to wrap insulated piping on ships and exhaust pipes on planes. A spectacular war application has been use of Fiberglas cloth for glare shields for the magnesium parachute flares of about 1,000,000 candlepower, employed by the Army Air Forces to illuminate the objective of a bombing attack.

War requirements have been largely responsible for two recent developments that forecast broader peace-time uses of Fiberglas textiles in the industrial field. One of these involves use of the textiles as reinforcement for plastics; the other takes the form of Fiberglas cloths coated with synthetic rubbers or resins.

In fabricating Fiberglas-reinforced plastics, layers of Fiberglas cloth are impregnated with a low-pressure, thermo-setting resin and are placed, one on top of another, until a laminate of the desired thickness is built up. The laminate is then draped over, or shaped in, a mold. The mold, and the laminate formed to the desired shape, are placed in an oven where the laminate is cured.

Fiberglas plastic combinations possess extremely high strength in proportion to their weight. Test specimens have shown tensile strengths of from 50,000 to 80,000 pounds per square inch, compression strengths of over 50,000 pounds per square inch, and impact strengths of over 30 foot pounds, as compared with 2 foot pounds for ordinary plastics.

Aircraft parts—including cabin structures of helicopters built for the armed forces—have provided the most spectacular applications of Fiberglas-plastic combinations, but designers and engineers are already experimenting with the material for many post-war civilian uses. These include strong light-weight luggage, boats and canoes, furniture, kitchen and bathroom assemblies, refrigerator and radio cabinets, and dozens of additional products where attainment of light weight combined with high strength and ease of fabrication is the goal.

The needs of the armed forces have led directly to the development of Fiberglas fabrics coated with synthetic rubbers and resins. These coated fabrics have high tear strength, withstand repeated flexing, are resistant to destruction by fungi, and have high dimensional stability. Other properties vary with the coating employed, but rubber-coated Fiberglas fabrics are being produced which are flame-proof and have high resistance to moisture penetration and to the effects of contact with gasoline, oil, chemicals and greases.

High tear strength and dimensional stability, or resistance to fungi, heat, chemicals, or oil, are responsible for most of the current uses of the coated glass fabrics. These present uses include aircraft battery covers, oil pressure switch diaphragms, aircraft tape for expansion joints of hot air ducts, water tanks for troops in the field, protective clothing for workers in chemical plants. Possible future uses include tarpaulins and other waterproof covers for machinery, waterproof containers for delicate instruments, and carburetor diaphragms. Another possibility is an awning that will not burn if a lighted cigarette is tossed upon it from an upper-story window.

Ever since Fiberglas fabrics were first produced in 1936 we have realized that they possess properties that make them of great potential value as decorative materials. When I refer to the great potential value of Fiberglas decorative materials, I mean this in the literal sense. We remember the fires that have taken a large toll of human life—the Boston night club fire, the burning of the Morro Castle, the terrible Iroquois Theatre fire—but we don't remember, or we never hear of, the hundreds of lesser fires that occur with monotonous regularity in hotels, restaurants and night clubs, in stores, schools and theatres, in all the many places where large numbers of people congregate.

Over and over again, investigations of such fires have shown that the rapid spread of the flames was due to the presence of inflammable decorative materials. For years it has ben recognized that the use of inflammable draperies in such places of public assembly constitutes a special hazard to human life. Yet the hazard still exists and still takes its toll.

True, we have made long strides in developing processes for flame-proofing inflammable fabrics, but building commissioners and other officials responsible for public safety tell us that only fabrics woven of inorganic yarns that are inherently incombustible can meet the requirements for complete fire-safety in places of public assembly. Glass is such a substance.

In the home, the feature of fire-safety is of lesser importance, for there is not the same danger of mass panic that there is in a theatre, night club or school. But the fact that Fiberglas fabrics will not shrink or stretch, that they are proof against moths, mildew, and decay, makes them potentially suitable for wide use as drapery materials in the post-war home. This would be particularly true of seashore homes where salt air and strong sunlight play havoc with some of the more familiar drapery materials, and where high humidity often causes other materials to stretch and sag.

The extent to which Fiberglas fabrics will be used for other decorative purposes in the home cannot be clearly foreseen at this time. They are not suitable for use as upholstery fabrics or for other applications where they would be subjected to repeated flexing or friction. This, by the way, rules out their use for wearing apparel.

Combinations of Fiberglas fibers with other fibers—cotton, or rayon or silk—also offer possibilities in decorative fabrics. Here the glass fibers would be employed both for unusual design effects and to give added dimensional stability to the fabric. Research in such combinations was under way before the war, and has been resumed in recent months, but it is still in its initial stages.

The progress now being made in developing the potentialities of Fiberglas decorative fabrics is extremely encouraging, although this does not mean we have found a satisfactory solution for all the problems involved. We would be much nearer a solution if it had not been for the war. Since before Pearl Harbor our production and research facilities have been concentrated upon meeting the requirements of the armed forces. Until very recently we have been able to devote a minimum of attention to the consumer field.

The war is still on. Military requirements for Fiberglas materials are still very heavy. Our manpower resources are

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What We May Expect from Resins in the TREATMENT OF COTTON*

D. H. POWERS
Monsanto Chemical Company, Everett, Mass.

IN OUR constant effort to improve our textiles we have changed the count, changed the twist, changed the weave, and more recently changed the fiber to produce new fabrics and better fabrics. But the possibility of producing *new* fabrics from *old* fibers by the use of resins is a possibility which we should consider, especially here in the South where Cotton is King.

Markets for cotton can expect to grow if (a) its cost is reduced, (b) its quality is improved, or (c) its range of usefulness is widened. Present policies and pressure groups make it unlikely that the price of cotton will drop, even though domestic prices are above the world market prices. It seems probable that these higher prices of cotton will tend to restrict its markets and decrease its use, particularly if other synthetic fibers become cheaper. Even though the yield of cotton is now estimated at 285 pounds per acre, nearly 60 pounds higher than the previous ten year average; even though mechanical pickers show promise of lower cost of harvesting —all these benefits do not widen the markets for cotton if they do not lower its selling price. These benefits help the farmer and he is certainly entitled to whatever help he can get, but they do not open up wider markets and greater sales for cotton unless they bring down its selling price.

The quality of cotton has received tremendous study in an effort to produce finer, longer staple by better breeding, fertilizing, and cultivation, but the figures of actual improved production for the past twenty years are not too encouraging. Latest figures indicating the production of American-Egyptian and Sea Island cotton show little more than double the production of twenty years ago, and the total production of these finer grades in 1943 is not over 1 per cent of the total cotton grown in the country. Research workers are doing an excellent job in tracing the growth of the cotton hair from the first seed cell of the seed coat to the final cotton fiber. All of these researches lead us to one conclusion, namely, that the full grown cotton fiber is a remarkably strong, durable, and tough filament with a tensile strength of close to 100,000 pounds per square inch, with a remarkably high wet strength, and with an elasticity adequate for most types of spinning and processing. Recent breeding studies show a possible increase in strength of from 80,000 pounds to 90,000 pounds per square inch for better grades of cotton.

All of this study leads to a surprising observation: the properties of the cotton fiber are truly remarkable, but we do not utilize more than one-fourth to one-third of these properties. If we are going to waste 65 per cent to 75 per cent of the strength of cotton, improved fiber strength is of little value, and the price istelf must be low because we waste so much of its value.

The range of usefulness of the cotton fiber can certainly be widened if we can better utilize its strength, or at least make use of a higher percentage of its strength. It should also have a wider usefulness if we can improve its resilience, its water resistance, its softness, its luster, and generally make better use of the remarkable aging qualities of the cotton fiber. It is suggested that the different resins and chemicals offer possibilities and promise along this line of attack. In the past we have tried to make the resin contribute the added strength and also add the aging qualites that we wanted, but all too frequently we failed because few if any of the plastics can show physical properties which can approach or compare with the properties of the cotton fiber itself. With a better understanding of the problem it is hoped that we can widen the range of cotton's usefulness by using resins to help utilize the qualities which the cotton already possesses.

Some of the possibilities which deserve study are:

(1) *Improved strength* of cotton yarns by improving the friction between the fibers.

(2) *Improved coatings* by utilizing more of the strength of the cotton backing and making it an integral part of the coating.

(3) *Improve suitings* by imparting greater resilience to the cotton fiber without impairing its strength or softness.

(4) *Improved blankets* by imparting greater resilience to napped or brushed fabrics so they may retain their thickness, on which their warmth is dependent.

(5) *Improved outer garments* by imparting greater water resistance and repellency to the naturally adsorbent cotton fibers.

(6) *Improved industrial fabrics* by improving the adhesion between the short cotton fibers so that fabrics present a tough continuous surface against wear and abrasion.

(7) *Improved washables* by reducing shrinkage and slippage during washing. Here again decreased water adsorbency helps.

(8) *Improved tentage* by reducing the sensitivity to attack by mold and bacteria and by reducing its ease of burning or charring.

(9) *Improved luster* by imparting a durable surface luster which withstands washing, as is evidenced by the growing popularity of the washable glazed chintz.

(10) *Improved finishes* by imparting a durable finish to all types of work clothes and garments so that the customer will come to realize that cotton garments will hold their original appearance and character during their entire life.

All of these effects must, of course, be durable or permanent and last the life of the fiber, and it should be noted that chemical and resin researches have indicated a possible solution to each of these problems. At the present time a great majority of the research effort is on military fabrics. It is true that some of the other fibers, particularly rayon, are taking greater advantages of these possible improvements. But cotton, and cotton alone, appears to be the *one* fiber that brings all of the needed strength, toughness, and remarkable aging qualities, and needs only a better utilization of its character to find much wider uses.

We hear about the importance of cotton for winter garments and ski jackets, but we must remember that an adsorbent cotton fabric would be useless for this purpose. We hear of tremendous yardage of cotton for tentage, but we must remember that the mold sensitive, fire sensitive cotton fiber is of little value for this field. Only by chemical and plastic modification of cottons have these new markets been achieved.

IMPROVED STRENGTH

It has been repeatedly shown that a cotton yarn is one-third to one-quarter as strong as the cotton fibers in that yarn. The slippage of the fibers long before they break causes this poor showing. The Re-

* Presented at meeting. Southeastern Section, November 25, 1944.

search Division of the National Cotton Council at Austin, Texas, has been doing some excellent work studying the effect of high polymers on the properties of cotton fibers. Studies of sizings have shown that no tough resin coating appreciably improves the strength of tight spun cotton yarn, since the thin cotton fiber is much stronger than the tough resin film. On the other hand, the use of a plastic which will increase the surface friction of the cotton fibers greatly increases yarn strength, and when it is used in warp sizing it markedly reduces loom stoppage. It has been pointed out that a utilization of fifty per cent more of the actual fiber strength would have wide significance in the field of industrial yarns. Particularly promising in the production of stronger yarns is the use of thermosetting resins which will slip or slide during the drawing and carding, but which will be sticky or adhesive during twisting. A new resin, *Syton*, which is an inorganic type polymer, has consistently shown great improvements with the least resin required. The further advantage of the Syton type resin lies in the fact that it requires no curing, is applied from water, and shows no stickiness or tackiness on application.

IMPROVED COATINGS

The coating field has long been a large user of cotton fabrics, but it has always been the custom to use the cotton solely as a backing, and the resin coating or film determines the quality or value of the resulting material. All too frequently the cotton backing was far stronger than the coating, and all too frequently the thin surface film pulled away from the backing and the cotton was blamed for poor anchorage. Recent developments with water-dispersed coating resins of the *Merlon* type indicate that they penetrate the fibers and utilize the strength and toughness while eliminating entirely the problem of coating anchorage. It is surprising to note that fabrics impregnated in this way may show two to three times the strength and toughness of a coated fabric. Then too, this type of coating opens the possible production of impregnated fabrics by textile finishing mills which normally cannot handle the solvent type coatings. Here again, the production of stronger coated fabrics opens wider markets and a less expensive method of application may further widen this field.

IMPROVED SUITINGS

Recent years have seen the rapid growth in importance of resin treated rayon suitings. These rayon suitings have style, coolness, and resilience. On the other hand, cotton suitings showed far less growth, possibly because they wrinkled easily. The Navy clearly showed that cotton suitings have remarkable toughness and durability. It is suggested that the incorporation of some of the newer *Resloom* type melamine resins will impart a far greater resilience to these cottons. The development of well styled cotton suitings with the addition of resilience and ability to keep their shape would certainly open new markets for this fiber and enable it to compete in much wider fields.

IMPROVED BLANKETS

The warmth of a blanket is dependent on its thickness and the amount of "dead air" that it holds. While freshly napped cotton blankets are warm, they tend to flatten and become thinner with use and washing, and hence lose much of their warmth. The use of the newer Resloom type melamine resins offers the possibility of producing a blanket that will hold its thickness and "dead air" space due to the stabilizing action of the Resloom. This resin gives the fiber a "memory" so that it tends to retain the thickness and fullness it possessed when the Resloom was impregnated in the fibers. Here again, new possibilities and new markets open up for cotton in the design of blankets combining the toughness of the cotton and adding the resilience of the resin.

IMPROVED OUTER GARMENTS

Recent work has shown that cotton jackets are excellent for cold weather and outdoor wear. Here the adsorbent cotton fiber is unsuitable for outdoor wear because it quickly becomes soaked in a driving rain. However, if the cotton is rendered hydrophobic by the application of resins or chemicals, this new field of application opens up. Recent researches show that certain resins give cotton durable water repellency and add toughness and strength to the fabrics. Here we see a large and important market opening up for cotton goods by reducing its hydrophilic character and imparting moisture proofness. By resin treating the yarns we obtain a water repellent fabric and by filling up the interstices between the yarns we are able to obtain waterproof fabrics.

IMPROVED INDUSTRIAL FABRICS

Industrial fabrics have long been the backbone of the cotton industry, but recently we have seen synthetic yarns cutting into this market because they were better developed to fit a given problem. If we can modify and improve cotton to better fit it for special applications, it can expect to gain new markets. Present work with resin dispersions indicates that they can be used to give cotton fabrics a smoother, flatter face which wears better, which resists mold better, and which is generally more durable. A tougher resin surface size gives the yarns greater luster and smoothness, so that they show better wear and pick up less dirt. Here again it is essential that the resin film be as thin as possible, allowing the tough cotton core to supply the strength and elastic qualities for which it is outstanding.

IMPROVED WASHABLES

The growth of rayons in the dress goods field may be attributed in large part to the fact that they are being developed for washable goods with fast colors and stabilizing resins. It has clearly been established that low concentrations of the reactive resin formers impart to cotton fabrics a greater stability, a markedly reduced shrinkage, and a much lower tendency to slip. It has been possible to develop fine cottons with excellent washability by incorporating low percentages of resin formers. More recent work has shown that the washability of cotton is appreciably increased by treating it with low concentrations of durable water repellents.

IMPROVED TENTAGE

It is hardly necessary to point out that not a yard of cotton duck could be used for tentage in the South Seas if it were not treated. The sensitivity of cotton to bacterial and fungicidal action precludes its use in the tropics unless the fiber is protected. It is also true that the inflammability of cotton is a serious disadvantage, and until a means of reducing this combustibility was developed, this tremendous outlet for cotton was seriously threatened. It should be realized that we still need better cotton with better mildew and fire resistance, and as we improve these characteristics of this fiber we can expect to widen greatly its markers. The use of resins has been essential in the present solution of these problems, and future improvements will involve resins specially developed to fit these needs. Incidentally, this market for cotton at the present time is probably as great as most of the other markets put together.

IMPROVED LUSTER

The last few years have seen the rapid growth of washable lustrous cottons in the field of glazed chintz. Further improvement of this resin finish is opening wider markets in the dress and upholstery field, which were previously slipping away. Here is a clear-cut case where the cotton supplies the strength and toughness, but the resin supplies the surface luster or finish which the basic fiber lacks. The basic qualities of the cotton adapted by a new synthetic resin to fit new markets makes possible wider sales for cotton goods at higher prices.

IMPROVED FINISHES

Far too high a percentage of heavy cotton goods are finished with a fugitive non-durable finish which comes out in

the first washing. Too often the impression is created in the customer's mind that the cotton fabrics are not durable and lasting because this surface finish is easily removed. If we are going to establish cotton in its rightful leading position and if we are going to sell the customer on the true durability of cottons, we must put it on the market with a finish that will last. Sheetings and shirtings that lose their surface finish on the first washing are only slightly cheaper than sheetings and shirtings which do not change on repeated washings, but the impression created on the customer by these fabrics is entirely different. Here is a place where resins and plastics can really be of assistance in establishing a permanent finish for cottons so that they will be generally recognized as durable and serviceable merchandise.

Cotton has plenty of competition ahead of it to meet the new fibers and new constructions with which it must compete in the postwar world. The addition of plastics should be seriously considered, as they will assist Cotton to demonstrate those outstanding qualities which it already possesses. If its strength, toughness, durability, and elasticity can be more fully utilized, Cotton will once again find itself the basis of all important textile fabrics of the future.

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Synthetic Fibers—

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There seems to be no reason for not having something like this on the majority of the fabrics of the future. For satisfactory results, it is essential that cloth technicians and finishers work as a team. The cloth must be designed so as to provide sufficient room for the resin. Long and coarse staples are desirable for the sake of resiliency, high spinnability and low twist. The cloth is to be entirely relaxed, fully shrunk, and, of course, nearly bone dry before curing. The chief requisites for success are desirable cloth construction and finishing under low tension. Urea formaldehyde does not possess any shrinking properties. It is placed on the cloth to anchor the fiber and no satisfactory degree of stability can be achieved unless the fabric is fully shrunk at curing time.

When meditating on what old and new synthetic fibers will do in fabrics of the future, one can not stop at the possibilities offered by the fiber itself. Many other influential factors enter the picture, such as: (1) The "raring to go" attitude of the textile industry to promote rayon and synthetics. (2) The definite trend to design new machinery and to devise new processes to suit synthetics, while in the past the fiber had to take its chances with conventional methods and equipment. (3) The benefits derived from the fact technicians are selecting the fiber best suited for a specific end use. (4) The release of ideas conceived by numerous stylists and technicians and held in abeyance because of war restrictions. (5) The proven ingenuity of a large research group working incessantly toward greater achievements. (6) A concerted effort to control the properties of the finished goods so as to give the consumers greater value.

Gentlemen, I am one of the many who have implicit confidence in the future of synthetic fibers. You will agree that the scores of samples exhibited here tonight offer something real and novel. All these samples were produced with the facilities of the Textile Research Department of the American Viscose Corporation. Increase this array of fabrics commensurately with the tremendous ingenuity and facilities of the textile industry to be released when the war ends and you get a post-war picture which spells synthetic.

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Fiberglas Textiles—

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strained. We are still able to give only a fraction of our time and effort to anything other than the urgent needs of a nation at war. We cannot make any firm prediction as to when Fiberglas fabrics will be ready for, or available to, the consumer market. But as we look back over the many widely divergent requirements our fabrics have been able to meet because of their inherent properties, we become very confident of their future in this field.

We will need your help. Only teamwork can solve the many developmental problems. Once we are able to spend the necessary time and effort on their solution, we are certain that with your assistance a number of consumer products can be developed which will serve the public by meeting a real consumer need.

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MEETING, RHODE ISLAND SECTION

THE March meeting of the Rhode Island Section was held on Friday, the 23rd at 8:00 P.M. at the Providence Engineering Society Hall. This followed the two day meeting of the National Council and Research Committee at the same place. Many members of these groups attended our meeting and helped to swell the attendance to 250.

Chairman H. B. Sturtevant opened the meeting by calling on our President, William D. Appel, for a few general remarks about the activities of the A.A.T.C.C. as a whole. He was followed by Leonard S. Little who spoke of the Executive Committee on Research, its hopes and plans. Dr. Louis A. Olney then told some more about this work with greater detail.

The speaker of the evening was Hector C. Borghetty, technical manager, textile chemicals division, General Dyestuff Corp., whose subject "Post-War Possibilities in Finishing Fabrics" reviewed some of the influences war requirements had on demanding more durable finishes. With many new compounds available and better chemical control, the finishing part of preparing a fabric for the market is due for much more attention as the textile industry changes over to civiilan needs. A short question-and-answer period followed, and the meeting adjourned at 9:30 with a rising vote of thanks to the speaker.

Respectfully submitted,
R. W. JOERGER, *Secretary.*

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MEETING, PHILADELPHIA SECTION

A MEETING of the Philadelphia Section was held on Friday evening, April 20th, 1945, in the Mirror Room at the Hotel Philadelphian.

The chairman, Arthur W. Etchells, announced that the Philadelphia Section will hold their Annual Outing on Friday, June 22nd at the Melrose Country Club.

Mr. Etchells then introduced the speakers of the evening. The subject was: "Symposium on Test Methods for Grading Light Fastness." The speakers were: Capt. Stanley Backer, Dr. Herbert F. Launer, and Charles A. Seibert.

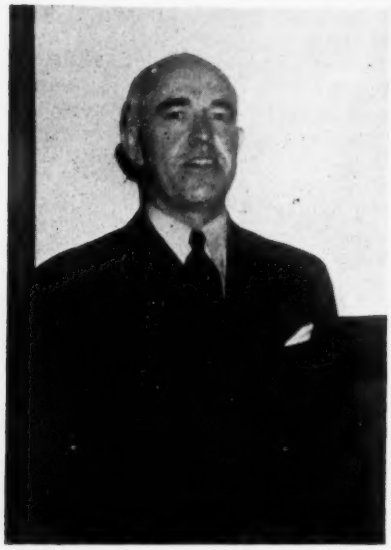
There were 155 present for the meeting and 132 for the dinner.

The meeting was adjourned at 11:15.

Respectfully submitted,
A. E. RAIMO, *Secretary.*

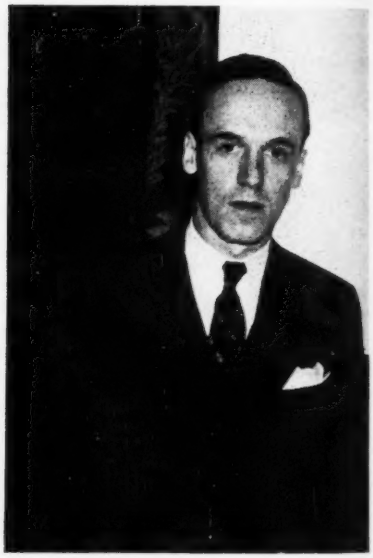
AMONG THOSE PRESENT AT THE MEETING OF THE NEW YORK SECTION ON MARCH 16TH, 1945

The report of the meeting was published April 9th



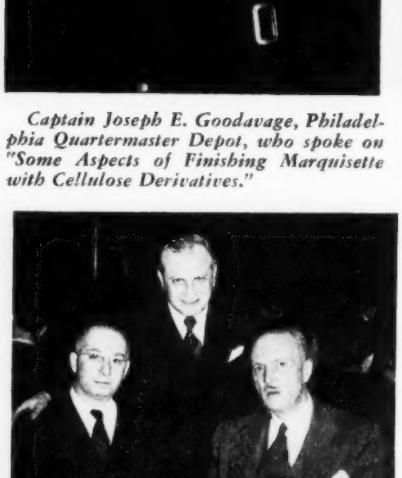
Alden D. Nute, Calco Chemical Division, American Cyanamid Co., who spoke on "Some Recent Aspects in the Finishing of Textile Fabrics with Melamine Resins."

Captain Joseph E. Goodavage, Philadelphia Quartermaster Depot, who spoke on "Some Aspects of Finishing Marquisette with Cellulose Derivatives."



Robert R. Ackley, Fellow for the Onyx Oil & Chemical Co. at the Mellon Institute of Industrial Research who spoke on "The Softening and Lubrication of Textiles."

Emmett Driscoll, Turner Halsey Co., chairman of the New York Section, who presided at the meeting.



Photos by

John Trezise
Onyx Oil & Chemical Co.

CALENDAR OF COMING EVENTS

Meeting, New York Section, Downtown Athletic Club, New York City, May 18, 1945. Symposium on Correlation of Test Methods with Consumer End Uses. Speakers: Henry F. Herrmann, General Dyestuff Corp., "Informative Labeling"; Dr. William E. Coughlin, Good Housekeeping Institute, "Meeting Consumer Needs in Textiles"; H. A. Ehrman, National Bureau of Standards, "The Importance of Standard Test Methods, Ratings and Terminology for Color Fastness." Annual Business Meeting.

Meeting, Northern New England Section, Andover Country Club, Andover, Mass., May 25th, 1945. "Court Scene"—The court will try the case of "Synthetic Detergents vs. Soaps."

Meetings, Council and Research Committee, New York City, June 22, 1945. Chairmen of Sub-Committees who wish to hold meetings on June 21st should notify Dr. Louis A. Olney.

Outing, Philadelphia Section, Melrose Country Club, June 22nd, 1945.

OTHER ASSOCIATION MEETINGS

Meeting, American Association of Textile Technologists, Builders Club, New York City, June 6th, 1945.

Medal Meeting, American Institute of Chemists, Columbus, Ohio, May 11th, 1945.

THE SOIL BURIAL TEST

for Rot-Proofed Cotton Fabrics

J. D. DEAN, W. B. STRICKLAND and W. N. BERARD

Southern Regional Research Laboratory, New Orleans, Louisiana*

DURING the past two years numerous treated fabrics, chiefly of the sandbag and camouflage type, have been tested for rot resistance by the soil-burial method at the Southern Regional Research Laboratory. This means of determining the effectiveness of proofing treatments has of late attracted increasing attention, and many inquiries have been received in regard to the technique employed and results secured. It is hoped, therefore, that the following account of a fairly extensive experience with the test may be of some general interest. A preliminary study made at this Laboratory of the soil-burial method has been described in recent issues of the AMERICAN DYESTUFF REPORTER.[1]

Although many complications are encountered in actual use, the principle upon which the soil-burial test is based is relatively simple. Any natural soil that is capable of supporting a good plant growth may be assumed to possess a large and varied population of microorganisms, among which there are always some cellulose-destroying fungi and bacteria. If unprotected medium-weight cotton fabric is buried to a depth of a few inches in such soil, under conditions of moisture and temperature favorable to microbial activity, it will be subjected to so severe an attack by the soil organisms that after three or four days the breaking strength will be considerably reduced; and if the burial is continued for several days longer, the fabric will be partly or wholly destroyed. If a similar fabric has been previously treated with some good rotproofing compound, several weeks of burial will be required before serious deterioration occurs. Since breaking strength determinations can be used as a fairly accurate measure of the resistance to rotting exhibited by the treated fabric, it would appear possible to determine the effectiveness of a proofing agent, or to compare the rot-resisting properties of different agents, by burying treated samples in biologically active soil under controlled conditions and observing the strength losses that occur during definite time periods. The effects of soil burial upon protected and unprotected samples of cotton osnaburg after different intervals of exposure are shown by Figure 1 and the accompanying tabulated data.

The terms "mold" and "mildew" are quite commonly used to describe the effect of microorganisms upon textiles, usually without much attempt to specify the exact degree of damage resulting, and a mildew-resistant treatment may be broadly defined as one that protects against such attack. On scientific grounds it may be preferable to distinguish between the superficial molds, which develop on textile materials without causing weakening, and those organisms, both fungi and bacteria, that actually destroy cellulose. It is primarily against the rotting action of the latter organisms that protective treatments are required for fabrics of the sandbag type. These fabrics are usually in continuous contact with soil during service, and as a result are subjected to conditions that promote rapid deterioration. In addition to microbial attack, the fabrics and their protective finishes may be injuriously affected by other factors such as soil acidity or alkalinity, the absorbing properties of various soil constituents, and the action of weather. A satisfactory evaluation of rotproofing treatments should therefore include resistance to the effects of the numerous destructive forces to be encountered, and it is to meet this requirement with special reference to soil contact that the burial test for rotproofing treatments has been developed.

The mechanism of microbiological destruction of cellulose is presumed to be much the same in all cases. It appears to be the prevailing opinion that when certain organisms are brought into contact with cellulosic fibers under favorable conditions their carbon requirements are satisfied through their power of secreting special enzymes that hydrolyze the insoluble cellulose to soluble products, with consequent destruction of the fibers. For present purposes it may be sufficient to consider the rotting of fabric in soil, with which this work is particularly concerned, to be the result of severe microbial attack under conditions that are in general highly favorable to the development and activity of soil organisms.

Soil-burial testing of proofed sandbag fabrics was undertaken with the purpose of securing in the most practical way information about the relative effectiveness and probable service performance of numerous protective treatments. The work was to be handled by textile chemists, instead of microbiologists, employing the technique that had been recently developed by investigators in the Department of Agriculture, substantially as later published by the American Society for Testing Materials in Tentative Standard D684-42T, Tentative Methods of Test for Resistance of Textile Fabrics to Microorganisms.[2] A composted soil was prepared by mixing equal parts of fertile topsoil, sand, and well rotted stable manure, and the first beds were made by placing this mixture in shallow wooden boxes, measuring about 4′ x 4′ x 1′, which were installed in a greenhouse. A few months later, more burial space having become necessary, the work was transferred to several large outdoor beds which had been constructed in the Laboratory grounds. These beds were at first made by placing the composted soil on 2 inches of sand and gravel laid in excavations cut about one foot deep into the natural soil, but to permit better control of moisture content the composted soil was subsequently transferred to large wooden trays or boxes which were raised a foot or two above ground level. In both cases a thermostatically controlled grid of electric heating cable was laid between the sand and the composted soil to maintain the latter at the desired temperature, and the beds were covered by transparent panels of plastic-coated mesh material to exclude rain.

In accordance with the A.S.T.M. Tentative Standard previously mentioned, an attempt was made to keep the soil at a temperature of 90°F.±5° and at a moisture level "best for growing plants," the latter condition for the particular soil in use being subsequently fixed at a moisture content of 28 to 30%, above the oven-dry weight, or 65 to 70% of total moisture-retaining capacity. Fabric specimens measuring 6″ x 3″ were buried vertically to a depth of 3 inches, the upper half of each specimen being bent over and pressed flat on the surface of the soil. Sufficient specimens of each fabric were

* One of the laboratories of the Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, U. S. Department of Agriculture.

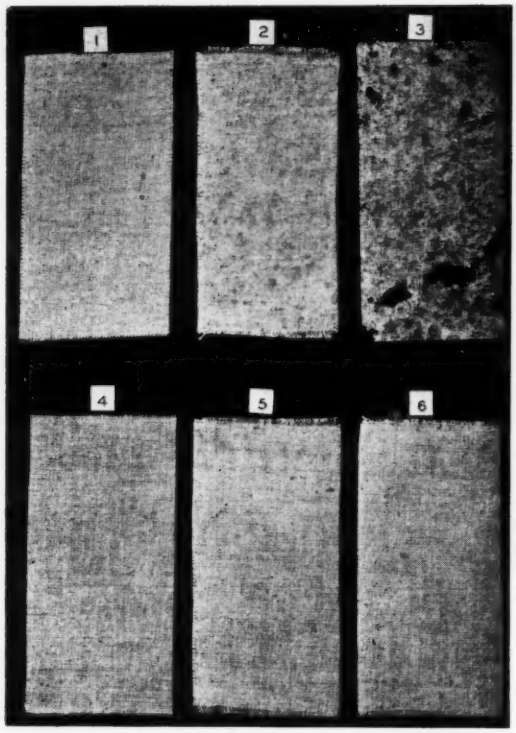


Figure 1. Effect of Soil Burial on Gray and Treated Cotton Osnaburg

Specimen Number	Treatment	Burial Period Days	Breaking Strength Loss %
1	None	0	0
2	None	3	74
3	None	5	100
4	Copper Naphthenate	0	0
5	Copper Naphthenate	21	31
6	Copper Naphthenate	35	70

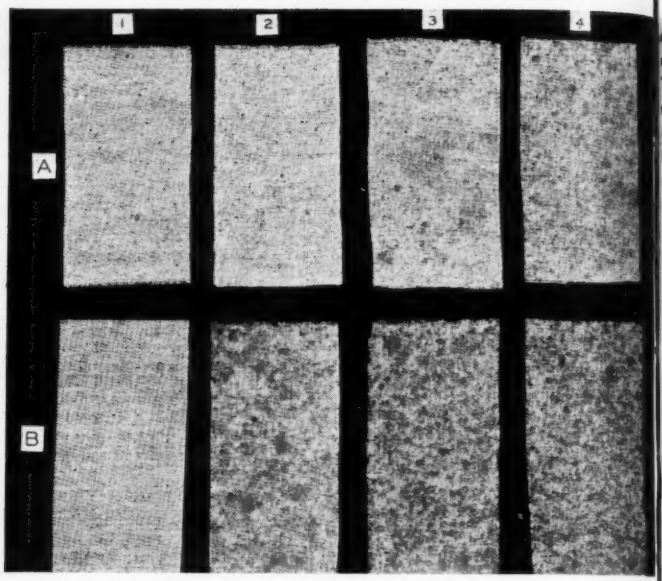


Figure 2. Soil Burial of Gray Cotton Osnaburg Under Different Conditions

A. Outdoor Bed. (4-Day Burials)

Specimen 1—Unexposed
Specimen 2—Burial at ¼" level ..... Strength Loss 40%
Specimen 3—Burial at 1" level ..... Strength Loss 65%
Specimen 4—Burial at 4" level ..... Strength Loss 80%

B. Indoor Bed. (4-Day Burials)

Specimen 1—Unexposed
Specimen 2—Burial at ¼" level ..... Strength Loss 85%
Specimen 3—Burial at 1" level ..... Strength Loss 90%
Specimen 4—Burial at 4" level ..... Strength Loss 90%

buried to permit the removal of at least 5, preferably 10, replicates for breaking strength determinations after burial periods of 3, 6, 9, and 12 weeks.

It was realized from the first that in a test which involved so many unknown factors no very high degree of uniformity could be expected in the results, and it was considered advisable in each test to include specimens of a standard treated control-fabric which could be randomized among the test specimens, thus giving a common basis on which to judge the rotting resistance of different treatments. Sets of untreated cotton-fabric specimens, placed in the beds at regular intervals, served as a general check on the cellulose-destroying activity of the soil over long periods of time. The results of many tests conducted in this manner made it clear that the evaluation of any given treatment must be largely based upon a comparison of its performance during soil burial with that of the treated control-fabric which accompanied it. Considering only the results of tests made at the same time, valuable information could be secured by this comparison of the relative resistances to rotting observed in fabrics treated with known and unknown proofing agents exposed under identical conditions. On the other hand, such wide variations frequently occurred in the performance of the control-fabric, when tested at different times, that a satisfactory order-of-merit rating for different proofing treatments was very difficult to achieve. In general, by the method in use it was possible to distinguish an effective from an ineffective proofing agent, and to grade others as falling somewhere between these extremes, but more exact classification was hardly attainable. Improvement in testing technique to a degree that would yield more consistent and reproducible results throughout a series of tests was felt to be urgently needed.

Complex problems of soil microbiology were beyond the scope of the investigation undertaken, but as the work progressed it was observed that certain environmental factors in the soil burial of fabrics influenced strongly the rate and extent of rotting, and need was felt for establishing a closer control of these factors. Chief among them were the composition and texture of the soil used and the method of burying the specimens; others were soil temperature, moisture content, and pH. An examination to determine the optimum soil-burial conditions was accordingly begun. It is obvious that in testing fabric specimens by soil burial all the environmental factors exert their influence simultaneously, and that the extent of rotting is the resultant of various forces acting together. For the sake of clearness, however, these factors may best be considered separately.

Soils of rather widely differing properties have been employed in burial testing by individual investigators, since no satisfactory single type appeared to be sufficiently widely distributed or universally available. Standardization of a testing soil is, in fact, an almost insoluble problem, a point which has been emphasized by Barker, Greathouse and Marsh.[1] A composted soil of the type employed is apparently subject to continuous biochemical change. Different soils also differ in physical properties, as, for example, adsorptive capacity, and their effects upon proofing compounds may vary correspondingly. To a considerable extent, this lack of a standardized soil may interfere with uniformity of results among different workers; however, from such information as is available it seems probable that fairly good general agreement can be secured in the evaluation of proofing treatments, even when the soils used are not identical in composition.

Experience has indicated certain prop-

erties that should be possessed by all soils used in testing, regardless of their origin. The most suitable soil is one sufficiently rich in cellulose-destroying organisms to insure vigorous rotting attack. It should be porous enough to permit ready penetration by air and moisture, and of a texture that favors complete and uniform contact with fabric specimens. Although the soil may contain some proportion of clay, it should not tend to pack too firmly or to become sticky when the moisture content is in the neighborhood of 30% above the oven-dry weight. The soil used in the work here described was easy to manipulate and exhibited a vigorous rotting attack upon cotton fabric under suitable conditions of moisture and temperature.

The position and manner of placing fabric specimens in soil were found to affect the rate of rotting. Inserting the specimens vertically into the beds by means of a flat blade is the simplest method, but in large-scale work, where hundreds of samples are handled, it is difficult to ensure uniform contact of soil with every specimen of fabric. This method also requires that a small portion of the fabric be folded over and around the blade; as a result, soil is frequently so throughly rubbed into the folded portion that rotting in this area is likely to be more rapid than anywhere else. Due to unavoidable variations in moisture and temperature at different levels in the large outdoor beds, particularly near the surface, there was a tendency toward graduation of rotting along the length of the vertically buried fabric strip. On the whole, more even rotting, and therefore a better condition for breaking-strength determinations, was obtained by burying the specimens horizontally three or four inches below the surface. It was subsequently shown that in cabinet-surrounded beds, with practically uniform temperature and moisture conditions maintained throughout the soil at all depths, concordant results were secured by either vertical or horizontal burial of specimens, provided that uniform contact with the soil was assured in either position. For general testing work, however, horizontal burial of specimens at depths greater than one inch is considered more dependable than vertical burial, and is now regularly employed. Figure 2 shows varying degrees of rotting and the corresponding strength losses observed in untreated cotton-fabric specimens buried horizontally for equal periods of time at different depths in outdoor and indoor (cabinet) soil beds. It will be noted that damage suffered in the indoor bed was practically uniform at all depths of soil below the ¼" level, in marked contrast to the variations occurring in outdoor burials.

It is generally recognized that warmth and moisture are necessary for development of fungi and bacteria, and optimum temperature and moisture ranges for the activities of various organisms have been carefully observed by different investigators.[4,5,6,7,8] Since it appeared desirable to determine, for the special soil mixture employed, the conditions of moisture and temperature at which the maximum rotting of fabric would take place, identical sets of untreated fabric specimens were buried for four-day periods in separate beds carefully made up to individual moisture contents (above oven-dry weights) of 10, 20, 30 and 40%, but all maintained at 85°F. The resulting average strength losses indicated that severity of attack increased with moisture in the soil bed up to 30%. In soil of 40% moisture content, which was beyond the moisture-retaining capacity, almost complete inhibition of microbial action resulted.

A second series of tests was run in four separate beds, all of 30% moisture content, in which temperatures of 65°, 75°, 85°, and 95° F. were maintained. Average strength losses observed after four-day burials increased with temperature up to 85° F., and fell off slightly at 95° F. The detailed figures for both series of tests are given in Table I.

TABLE I

Effect of Soil Moisture and Temperature on the Rotting Rate of Untreated Cotton Fabric

Temperature ° F.	Moisture (above oven-dry weight) %	Strength Loss (4 days burial) %
85	10	60
85	20	70
85	30	87
85	40	6
65	30	27
75	30	55
85	30	87
95	30	82

The tests described were made with triplicate burials of six specimens each, the figures thus representing the average strength losses observed for eighteen specimens in each determination. Although these average results cannot be considered absolute values, they are regarded as fairly representative of the effect of soil temperature and moisture on the rotting of unprotected cotton fabric. Assuming that the same general principles apply in the case of treated fabrics, a soil temperature of 85° F. and a moisture content of 30%, above oven-dry weight, were adopted as standard conditions to be maintained in all subsequent testing work. It may be noted that the difference between average strength losses for soil of 30% moisture content at temperatures of 85° and 95° F. is not significant, as it falls within the range of normal variations in fabric strength tests. The lower temperature was preferred, however, as being less likely to cause moisture loss by evaporation.

The work of other investigators[9,10] has demonstrated that the acidity or alkalinity of soil has an important influence on the resistance of proofing compounds when tested by soil burial. This fact has been recognized in the present work, but since the standard soil mixture used was neutral in reaction and had never displayed any marked change in pH throughout a long series of burial tests, it was not necessary to deal extensively with the question of acidity or alkalinity.

Tests carried out with untreated cotton fabric in portions of the standard soil that had been artificially adjusted to form a series of small beds ranging in pH from 3.0 to 10.5 showed maximum rotting in the neutral (unadjusted) soil. Other comparative tests made with the standard soil and several natural soils of different reactions (pH range 4.0 to 8.0) also showed maximum rotting in the standard neutral soil mixture. There was no reason, therefore, to attempt special adjustment of reaction in this soil, which regularly showed a pH of 6.8-7.5.

It has been seen from rotting tests of untreated cotton carried out under carefully controlled conditions (Table I) that a change of 10° F. in soil temperature may be responsible for more than 50% difference in loss of fabric strength during the same period of burial. In the outdoor beds the composted soil, 7" to 8" deep, was warmed in cool weather by electric heating cables placed at the bottom of the soil layer. During the winter season, differences in temperature as great as 20° F. had been noted between the 7" and 1" levels in these beds. To avoid such irregularities, it was decided to construct indoor soil beds enclosed in cabinets in which a constant temperature could be maintained, and in which the temperature of the soil, controlled by that of the surrounding atmosphere, would be the same at all depths and in all parts of the beds. Accordingly, there was installed in a basement room a testing unit, which consisted of three soil beds placed in a cabinet equipped with thermostatically controlled heating apparatus. Each bed was approximately 36" x 48" x 10" in dimensions, and the total capacity of the unit (Figure 3) was 225 6" x 3" fabric specimens. The freshly mixed soil was weighed in the air-dry condition, and its moisture content was determined before it was placed in the beds; when the soil was in place, a calculated amount of distilled water was added to bring the moisture content up to the desired 30%. After standing a few days to become evenly warm and moist

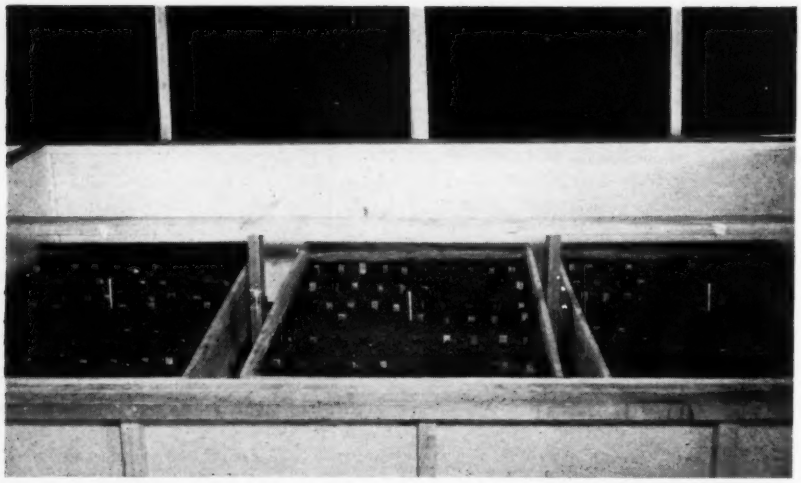


Figure 3. Indoor Soil-Burial Testing Unit. (Cabinet and Beds, showing Specimen Identification Markers)

throughout, the beds were ready for use. A relative humidity of about 70% prevailed within the closed cabinets, and under such conditions the loss of soil moisture by evaporation did not exceed 1% per day while a constant temperature of 85°F.±1° was maintained in the beds. Moisture determinations were regularly made on soil samples taken for the purpose, and evaporation loss was periodically replaced by adding a calculated amount of distilled water in a fine spray to the surface of the beds. Two additional units of the same type were subsequently constructed, thus increasing total testing capacity to approximately 675 specimens.

Through experience gained in such studies as have been described a standardized procedure has been adopted for soil-burial testing. The evaluation of an unknown proofing treatment is based upon a comparison of its performance with that of a known treatment on similar fabric under identical conditions of exposure to biologically active soil. For the standard control treatment copper naphthenate has been found generally satisfactory. This compound possesses fungicidal properties of a high order,[9] is sufficiently insoluble to resist leaching by water, and is readily applied to cloth as a solution in either petroleum solvent or ammonia, or in the form of an oil-in-water emulsion. Fabric that had been impregnated with a petroleum solvent solution of the naphthenate, adjusted in concentration to give 1% metallic copper on the dry weight of the cloth, was regularly used for the standard treated control in all tests for rotting resistance here described.

From a treated sample received for examination sufficient 6" x 3" specimens are cut (the long dimension in the direction of the warp) to permit withdrawal of at least five replicates for strength-loss determination by the grab break method at weekly intervals during six weeks' total burial, a period that has usually proved sufficient for the evaluation of cotton fabrics. If the amount of test material is limited, specimens may be cut 6" x 1½", and breaking strength determined by the raveled strip method. Burial of fabric specimens is normally made without any preliminary wetting out, leaching or impregnation with nutrient solutions.

In a bed of freshly mixed soil, which has been brought to standard moisture and temperature conditions, several inches of soil are raked back from the required area and the test specimens are laid flat on the exposed surface and pressed down gently to bring them into good contact with the soil. Similar specimens of the treated control are randomized among the test specimens. The upper soil is then replaced over the specimens and pressed down gently, care being taken to secure uniform contact without packing the soil to an extent that might limit oxygen supply to the aerobic cellulose-destroying organisms. For convenience in handling, a small wooden marker is attached to the end of each fabric specimen in the manner described by Bertolet,[10] the upper end of the marker, which carries an identifying number, protruding about an inch above the soil surface (Figure 3). The cabinet is closed and the specimens are left undisturbed in position. Soil temperature is continuously recorded, and soil moisture is periodically checked by analysis. At weekly intervals 10 replicates of test and control specimens are removed from the bed without disturbing adjacent specimens, brushed gently, washed free of soil, dried, conditioned for 24 hours at 65% R.H. and 70° F., and the warp breaking strength determined. Average strength losses for the different treatments are calculated in percent on the average breaking strengths of the unexposed original fabrics.

The percent strength losses for a given treated fabric, determined weekly for six weeks of soil burial, may be recorded in tabular form for comparison with the corresponding control-fabric figures, or results may be shown in the form of graphs in which percent of strength loss is plotted against time of burial in weeks. In general, it is preferable to estimate proofing effectiveness by the average or over-all performance of the treated fabric up to the point of nearly complete degradation, without placing undue emphasis upon strength loss within any particular period. Since it was troublesome to compare tabular or graphical arrangements of weekly strength losses for a large number of samples, it appeared desirable to develop from the test data a numerical value for each treatment that would fairly express its rot-resisting qualities by taking into consideration the two factors of strength loss and time of burial. A method which is a modification of that used by Thaysen[11] was accordingly devised for deducing such a value, here designated "the soil-burial resistance number," for each treatment examined. Previous experiments with sandbags had indicated that an average strength loss of approximately 80% represented the maximum degree of deterioration at which a bag could continue to function in service. It was therefore considered that the time of standard soil burial required to cause a loss of 80% in strength of a treated fabric could be accepted as a significant measure of the rotproofing value of the treatment in question. In practice, the percent strength losses are plotted against time of burial in weeks and the time factor at 80% strength loss, usually expressed in days, is taken as the soil-burial resistance number of the treated fabric. The method of determining these values is shown in Figure 4, in which strength losses are plotted against time of burial, and soil-burial resistance numbers are derived for 7-ounce gray osnaburg treated with copper naphthenate (A) and with two other commercial proofing compounds, (B) and (C).

It has been previously stated that, in the testing procedure employed, the evaluation of an unknown proofing treatment is based upon a comparison of its performance with that of a known treatment of similar fabric under identical conditions of soil exposure. This comparative method of testing was adopted in the beginning as a logical procedure, since no standards of rot resistance were available; but as the work advanced and numerous different treating agents were encountered,

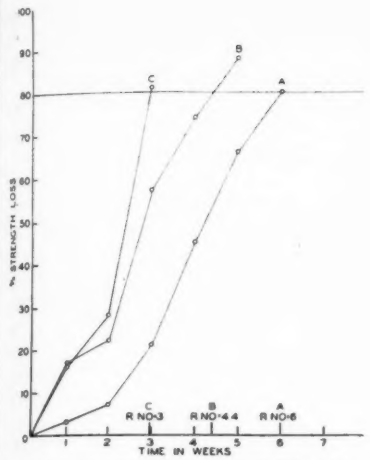


Figure 4—Derivation of Soil-Burial Resistance Numbers

Treatment A: Res. No. = 6.0 weeks or 42 days.
Treatment B: Res. No. = 4. 4 weeks or 31 days.
Treatment C: Res. No. = 3.0 weeks or 21 days.

it became apparent that a more extended knowledge of soil rotting, particularly in regard to the control fabric, was needed in order to arrive at a dependable classification of treatments. A fair comparison of the rot-resisting properties of a dozen or so proofing compounds requires the expression of all test results as nearly as possible in terms of the same value, but the amount of variation manifested by the control fabric in different tests was frequently sufficient to impair seriously its ability to serve as a common denominator for the series. Uniformity of burial-test results as a whole had been greatly improved by adoption of closely controlled physical conditions, but noticeable discrepancies in the performance of the control fabric from test to test continued to render uncertain the accuracy of comparisons made between different treatments.

Accordingly, studies were begun to determine more completely the rotting characteristics of the copper naphthenate-treated fabric when exposed to soil contact under the standard testing conditions. If a dependable average resistance number could be established for this treatment it would serve as a means of checking the control performance in each separate test, by indicating any significant deviation from normal that might occur in the resistance to rotting. The collection of data from carefully conducted burial tests of the treated control-fabric was therefore begun, with the purpose of establishing the desired standard of reference.

The ensuing examination of control-fabric rotting rates proved to be a complicated undertaking and emphasized the uncertainties still inherent in the soil-burial test, even after the standardization of such important factors as temperature and moisture conditions. A serious problem was early presented by the increased rate of rotting observed when repeated burials of the copper naphthenate-treated fabric were made in the same soil. Indications of similar acceleration in rate of rotting had been noticed in earlier work, but it was not until close control of environmental conditions had become possible that its occurrence could be definitely established and its extent measured.

In an investigation of this point, observations were made of changes in rotting rate resulting from repeated burials of both treated and untreated fabrics. Starting with a soil bed not previously used, successive 4-day burials of 10-specimen lots of untreated gray cotton osnaburg showed an increase in average strength losses from 79% for the first to 93% for the fifth set, after which no significant variation appeared in the losses recorded for six additional sets. A more extensive test was made of the copper naphthenate-treated osnaburg. In a bed of fresh soil, 60 replicates were buried, 10 random specimens being removed for strength determination each week for six weeks. At the end of this time the soil was thoroughly mixed, and a second set of treated specimens was buried. This procedure was repeated until 7 successive sets of specimens had been tested in the same soil. The resistance numbers determined for these tests, expressed in days of soil contact, were: (1) 45; (2) 32; (3) 27; (4) 27; (5) 21; (6) 20; and (7) 20. The results indicated that an increase of more than 100% in the rotting tendency of identical treated specimens had taken place from the first through the fifth successive burial in the same soil. The strength-loss graph for set (4) was practically identical with that for set (3), and it appeared that at this point the rotting tendency had leveled off. Burial of an additional set (5), however, showed further strength loss, and two more sets were therefore included. The results of these final sets, (6) and (7), were so close to (5) that the test was discontinued.

These observations, which definitely confirmed previous experience with copper-treated fabric, made it clear that the possibility of acceleration in rotting from continued use of soil would have to be considered in future testing work, although many problems suggested by the experiment remained to be solved. The soil used in testing the treated control-fabric showed practically no change in pH throughout, the readings being 7.10 at the start and 7.13 at the end. Analysis indicated that the copper content of the soil had increased from an original 4.50 to a final 26.85 parts per million. The simplest explanation of this accelerated rotting is to assume the multiplication of cellulose-destroying organisms in the soil during the repeated burials, perhaps accompanied by the development of copper-tolerant strains, although, of course, other more obscure causes may have been operating.

As a result of the experiments described, the conclusion was reached that it would be safer, although much less convenient, to conduct the tests of the control-fabric in beds of fresh soil. Accordingly, during the following months, 10 six-weeks burial tests of the copper naphthenate-treated osnaburg were made in separate beds of soil which had not previously been used for testing. The resistance numbers, calculated from the results of individual tests and expressed in days of soil contact, are given in Table II.

TABLE II
Soil-Burial Tests of Copper Naphthenate-Treated Cotton Osnaburg

Test No.	Resistance No. (Days)
1	45
2	45
3	37
4	36
5	39
6	39
7	44
8	42
9	45
10	46
Average	42

The tests enumerated were carried out over a period of about eight months, testing conditions being maintained as uniformly as possible throughout this time. It will be observed that the results of individual tests, expressed as their derived resistance numbers, range from a low of 36 to a high of 46 days required to produce the same amount (80%) of fabric degradation, the average for all tests being 42 days. Viewed statistically, the figures show a standard deviation of 3.5 days, with a coefficient of variation of 8.5%. This is perhaps not greater than should be expected in tests involving so many uncertain biological factors and conducted with a fabric that shows a strength variation coefficient of at least 5%. On the whole, it is felt that the resistance number of 42 days, derived from the averaged weekly strength losses determined in these tests (Figure No. 5), represents a dependable norm of control-fabric rotting under the standard testing conditions. This opinion was confirmed, in a rough but rather conclusive manner, by a survey of all previous testing results. Records were available for 36 earlier burial tests of the copper naphthenate-treated control-fabric which had been made in greenhouse and outdoor soil beds over a period of about 18 months. In

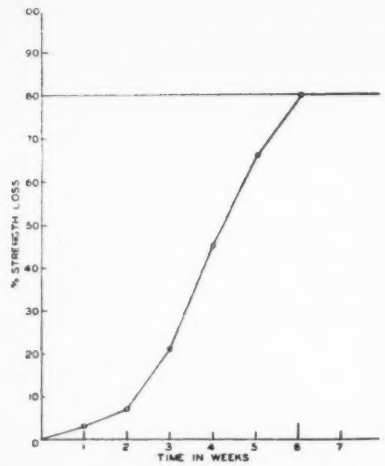


Figure 5. Normal Rotting of Copper Naphthenate-Treated Osnaburg (Average of 10 Determinations)

these less closely controlled tests, individual variations were naturally greater, but when the strength-loss figures for the entire 36 were averaged and plotted, there was obtained a mean resistance number of 41 days, which is in close agreement with the indoor-test average. The value thus established was employed as an extremely useful check on control-fabric performance in all subsequent soil-burial tests, particularly when comparing results from a series of tests in which the control was the only common factor.

Several other copper compounds, some of which are less effective proofing agents than the naphthenate, have been found responsive to the influences that produced accelerated rotting in the control-fabric. In tests where abnormally rapid rotting might occur it therefore appeared possible to apply to the resistance numbers determined for such treatments a correction based upon the deviation from normal observed in the treated control-fabric. It was not certain, however, that a parallel relation existed between this control-fabric and non-copper treatments, and to avoid the complications introduced by the factor of accelerated rotting due to repeated burials, it was finally made a regular practice to conduct all tests in beds of fresh soil. Under such conditions, regardless of the treatment, any marked departure from normal in control-fabric performance indicates that testing conditions are unreliable and that the determination should be repeated.

As experience with soil-burial evaluation of rotting resistance has been extended, it has become possible to arrive at a better appraisal of this testing method, which has occasionally been characterized as both time consuming and inaccurate. In attempting to assess soil burial critically, it must be borne in mind that the test is but one of several regularly employed in the evaluation of rotproofed textiles, and that in the work described its sole function has been to determine the resistance to rotting possessed by treated fabrics which in service are exposed to prolonged contact with soil.

In regard to the time element, soil burial as here used is definitely a test of the long range-evaluation type. Under the testing conditions that have been established, a well-protected cotton fabric weighing in the neighborhood of 6-8 oz. per square yard normally requires three weeks' burial in fresh soil before significant deterioration occurs, and for a satisfactory determination of rotting resistance it is preferred to extend the test period until strength loss amounts to approximately 80% of the original. Lighter fabrics are more rapidly attacked, and less effective treatments may be detected after a week or two of soil contact, but as a rule the evaluation of rotproofed sandbag fabrics requires from three to six weeks.

The general degree of accuracy and reproducibility of results that may be expected from the soil-burial method in its present stage of development has been indicated in the previous discussion. Although improved techniques and better control may be developed as knowledge of influencing factors is increased, it is apparent that as yet no high degree of scientific exactness can be claimed for the test. It has been possible to secure identical resistance numbers from carefully conducted duplicate determinations of the treated control-fabric, but in the results of tests made at different times variations of the order shown in Table II are likely to be encountered.

From the practical standpoint, the value of this test has depended largely upon its ability to furnish a reliable prediction of service performance for fabrics treated with a number of different rotproofing agents. The correlation of test results with the actual behavior of treated fabrics in service is therefore a matter of the first importance. To this end there is now in progress an extensive series of trials in which the service in days of protectively treated cotton sandbags is determined under conditions of natural exposure (Figure 6). Data so far available from these trials indicate that treatments which have consistently shown high resistance numbers in soil-burial tests make the best records in service performance. At the same time, rather wide variations in the rot resistance of certain treatments have been observed to occur with seasonal changes in climate and soil conditions. A fairly consistent classification of resistance numbers for these treatments can be obtained by carefully conducted soil-burial tests, but, in view of the variations found on natural exposure, it does not appear that slight differences in such numbers as determined by artificial testing methods are particularly significant.

It has been pointed out that in this work soil-burial testing was from the first directed toward selecting proofing treatments that might be expected to exhibit a high degree of resistance to the deterioration of cotton induced by soil contact. The conditions that may be encountered

Figure 6. Service Trials of Sandbags

by fabrics in military service are unpredictably varied, and it has been recognized that such conditions could not be completely reproduced in any practicable testing procedure. Attention has therefore been confined to determining under one set of standardized conditions the comparative resistances to rotting in soil displayed by numerous treated fabrics, employing in each test a treated control-fabric of which the rot-resisting qualities had been fully determined. From the standpoint of service performance, it has not always proved possible in such evaluations to distinguish minutely between treating agents of approximately equal proofing quality, but on the whole the selection of the desired types appears to have been reliably made. It has been gratifying to learn that these tests have played a part in the specification of proofing treatments that have successfully met the severe demands of service in many parts of the world.

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BOOK REVIEWS

A.S.T.M. STANDARDS ON TEXTILE MATERIALS (with related information). Prepared by Committee D-13 On Textile Materials. 1944 Edition. 473 pages, price $2.75. Published by the American Society for Testing Materials, Philadelphia 2, Pa.

This book contains the definitions and terms, methods of testing, and specifications for textile and related materials developed by the American Society for Testing Materials. Additional material appearing in appendices as information include, tables on basic properties of textile fibers, for yarn number conversion, and relative humidity; proposed recommended practice for designation of yarn construction, proposed recommended universal yarn numbering system, proposed recommended practice for calculating number of tests, drafts of new test methods, an American war standard for specification and description of color, and abstracts of papers presented at meetings of Committee D-13. The proposed methods and specifications in the appendix have not been formally approved by the Society and are distinguished from the standards and tentative standards by the absence of an A.S.T.M. serial designation. This compilation is published for the purpose of presenting in a single cover data that the Society believes to be of much importance to all who deal with textile materials.

CHEMICAL MACHINERY. An Elementary Treatise on Equipment for the Process Industries by Emil Raymond Riegel, Ph.D. Professor of Industrial Chemistry. University of Buffalo. 583 pages. 436 Figures. 90 Tables. Price $5.00. Published by Reinhold Publishing Co., 330 West 42nd St., New York City. 1944.

This book constitutes a collection of exact and useful information relating to apparatus and devices used in the chemical industries. Realizing that the great number of devices and their amplifications could not all be described in one book the author has endeavored to describe those of general application, and which serve a number of diverse chemical processes. For the most part only such apparatus is described that may be purchased from a manufacturer, who will also be able to supervise its installation. The author also confines his descriptions to large scale apparatus and not laboratory apparatus.

The text is primarily descriptive and liberally supplemented with drawings and photographs, but goes still further and discusses the reasoning governing the conception of the devices, their operation, and applications.

Manufacturers of machinery have cooperated toward the completeness of the book, by furnishing many photographs and drawings.

The book will prove of great value to every chemical engineer and chemical manufacturer, or any one supervising full scale chemical processes.

COMMERCIAL WAXES (Natural and Synthetic). A Symposium and Compilation. Edited by H. Bennett, Editor in Chief of The Chemical Formulary and Technical Director, Glyco Products Co., Inc. 583 pages. Price $11.00. Published by Chemical Publishing Co., Brooklyn, N. Y. 1944.

Although used in enormous quantities and for innumerable purposes, the chemical nature of waxes has never been too clear even in the minds of many chemists.

The author has endeavored in this book to bring together from many sources the most important information available, and it is believed that it will be of great value to the chemist, engineer, superintendent, purchasing agent, and student.

Today many synthetic waxes and wax like materials are replacing natural waxes for many purposes. While many waxes are used alone, others require blending and combustion, with resins and other waxes.

This book will undoubtedly be of value and great interest to those engaged in industries where waxes are used.

In Chapter VII, a section of more than 100 pages, there has been brought together formulas for many commercial and laboratory products in which all kinds of waxes are used.

CONFERENCE LEADER TRAINING, by Edward S. Maclin, President of West Virginia Institute of Technology, and Paul T. McHenry, State Teacher Trainer, Trade and Industrial Division, West Virginia State Department of Vocational Education. 77 pages. Price $2.50. Published by National Foremen's Institute, Inc., Deep River, Conn. 1944.

Like any good manual involving teaching this book proceeds in four steps.

In the first place, it endeavors to present in a concise form the needs for leadership training, and to develop an interest in learning the underlying principles of conference leading through individual study and by observing an experienced leader at work.

Secondly, to present in a practical form the various devices used in dealing with different situations, as well as the techniques involved in planning and leading a discussion.

Third, granting that an individual has a thorough knowledge of the above two training steps, a would-be conference leader cannot be successful until he has developed the ability to actually "do the job." He should be able to plan, lead,

and direct the thinking of a group.

Finally, individuals in training should have some criteria for judging the quality of their own efforts, and for making criticisms and commendations of the work of others.

HANDBOOK OF CHEMISTRY AND PHYSICS. A Ready-Reference Book of Chemical and Physical Data. 28th Edition. Charles D. Hodgman, M.S., Editor in Chief. 2,571 pages. Price $4.00. Published by Chemical Rubber Publishing Co., 2310 Superior Ave., N.E., Cleveland, Ohio.

This Handbook has become a more or less standardized book for every chemical laboratory, and the present edition contains so much valuable material that 35 pages are required for the index.

An attempt has been made to include material on all branches of chemistry and physics and the closely allied sciences, which would be likely to find any extended use. On the other hand, in order to retain the convenience of moderate dimensions and at the same time allow for natural growth due to the extension of knowledge in these sciences, and logical additions along lines already developed, it has seemed necessary to exclude types of material of use only in certain highly specialized lines of work.

Despite this and many other difficulties due directly or indirectly to war conditions, the new edition will carry a very considerable amount of completely revised material and the usual large number of changes and minor revisions.

The Table of Physical Constants of Industrial Organic Compounds has been completely revised and somewhat enlarged. Data for many new compounds have been furnished and a large number of changes made in the case of those previously listed.

Rapid changes in the plastic industry have been reflected in a complete revision of the Table of Properties of Commercial Plastics. Properties of the newer types of materials have been added and many of the older values revised.

Among other new features, there have been added to the radio section tables giving values of w and 1/w2 for frequencies of 100 to 2000 kilocycles.

HOW TO HANDLE LABOR GRIEVANCES. (Plans and Procedures) by John A. Lapp, LL.D. 294 pages. Price $4.00. Published by National Foremen's Institute, Inc., Deep River, Conn. 1945.

This book is the outcome of the experience of the author in handling arbitrations of labor grievances and in formulating and interpreting collective bargaining contracts. This experience has been reinforced by observation of the work of many grievance committees, by consultation with scores of labor and industry leaders, by a study of a large number of collective agreements and, not the least, by a review of the printed materials on the history of collective bargaining.

The subject is a vital one for present and future labor relations. Yet a review of what has been accomplished will give support to optimism about the future. Industry and labor have created, by the hard blows of experience, a system of constitutional government over wide ranges of employment. Today they are refining the processes to make them work with greater precision. Those who know little of the procedures in labor relations will do well to examine what has been accomplished on the anvil of experience.

The history of the development of grievance plans, the operation of grievance systems, and the problems which have resulted, make up the subject matter of this book.

The author is indebted to many labor and industrial leaders for information given in the form of printed and other material and by way of informal discussion. He is particularly indebted to the Twentieth Century Fund for permission to quote freely from that great volume, "How Collective Bargaining Works."

THE STANDARDIZATION OF VOLUMETRIC SOLUTIONS, by R. B. Bradstreet, M.S. Second Edition. Completely Revised and Enlarged. 151 pages. Price $3.75. Published by Chemical Publishing Co., Inc., Brooklyn, N. Y.

Volumetric analysis is a very important branch of quantitative analysis, but it is apparent that the value of the results obtained will be dependent upon the accuracy of the standard solutions used. Consequently a set of good methods for preparing such solutions is welcome to all analysts.

The use of this book will save much time for the laboratory worker as it brings together methods which have stood the test of laboratory experience, and has described them in a concise manner ready for rapid laboratory use.

This book is not for the beginner, since it presupposes a general knowledge and practice of analytical chemistry. It is a handy reference work for the man who must hurry to get his results. The discussions of the methods and their good and bad points are short and very useful, and the text is replete with helpful hints, equations, tables of important data, expressions for calculating normalties, etc.

Many equations are introduced which explain the chemical mechanism of volumetric analysis. The tables at the end of the book will be found particularly valuable for laboratory reference.

TRADE NOTES • NEW PRODUCTS

• CONFERENCE AT POLYTECHNIC INSTITUTE

Under the joint auspices of the Polytechnic Institute of Brooklyn, the Society of Rheology, and the Metropolitan Section of the American Physical Society, a one day conference will be held at the Polytechnic Institute Saturday, June 2nd, on "The Ultracentrifuge in Highpolymer Research." As a new development in highpolymer chemistry this conference will deal with the most recent applications of the ultracentrifuge to the study of the shape and size of large molecules.

In announcing the conference, Dr. Herman F. Mark, director of the new Highpolymer Research Bureau of the Polytechnic Institute and president of the Society of Rheology, said that this joint area conference has been arranged because of the prohibition against national meetings and because between the two societies there are large numbers in the metropolitan area who are interested in this subject and who can attend this conference without placing a burden on the transit facilities.

James Burton Nichols, research chemist of the Experimental Station of the duPont Company, will preside at the conference. Dr. Nichols is one of the two pioneers of the ultracentrifuge, having collaborated with Dr. Theo. Svedberg, the Nobel Prize winner of the University of Upsala, Sweden. Speakers will be Professor J. W. Williams of the department of chemistry of the University of Wisconsin, Professor Charles Beckman of the department of chemistry of Columbia University, and Dr. Kurt G. Stern, of the Highpolymer Research Bureau of the Polytechnic Institute. The researches to be reported at the conference deal with the physical-chemical properties of gelatine, which has been proposed as a blood substitute, starch and synthetic highpolymers.

• MEDAL MEETING, AMER. INST. OF CHEMISTS

William M. Jeffers, president of the Union Pacific Railroad and former U. S.

Rubber Director, will address the Medal Meeting of the American Institute of Chemists, it was announced recently. In compliance with the wishes of the ODT, the Institute has cancelled its annual meeting, and their gold medal will be awarded by the Miami Valley Chapter at its regular meeting in Columbus, Ohio, on May 11 at the Hotel Deshler Wallick.

The 1945 recipient of the medal is John W. Thomas, Chairman and Chief Executive of the Firestone Tire and Rubber Company, whose lifetime work in chemistry was capped by his contribution to the synthetic rubber program.

• OPENS CHICAGO SALES OFFICES

Warwick Chemical Company of West Warwick, Rhode Island has opened sales offices in Chicago, Illinois at 616 South Michigan Avenue in the Petroleum Building for the marketing of its products as well as the products of its subsidiaries. Mr. Maurycy Bloch is in charge of the office.

Mr. Bloch has extensive experience in the marketing of chemicals and petroleum waxes through his former connections, American Wax Refining Corporation of Jersey City, and Petrolite Corporation Ltd., of St. Louis, Missouri.

• RAYON PRODUCERS GROUP APPOINTMENT

Sir Samuel Salvage, as Chairman of the Rayon Producers Group, announces the appointment of Gardiner Hawkins as Executive Director and Treasurer of the Group. Mr. Hawkins announces his resignation as Vice President of Deering Milliken and Co., Inc., in order to be able to undertake his new position. He will not assume his new duties, however, until he has completed his present activities in Washington, D. C., as Price Executive of the Textile Branch of the O.P.A.

Mr. Hawkins has been with Deering Milliken and Co., Inc., since 1937, when he came to New York from Judson Mills, Greenville, S. C., where he had held the position of Secretary.

• FORMATION OF NEW DIVISION

Announcement was made recently by J. R. Van Fleet, President of United States Vanadium Corporation, a Unit of Union Carbide and Carbon Corporation, of the formation of a new Division to be known as the Metal Chemicals Division. This Division will manufacture and market inorganic compounds of certain metals including tungsten, molybdenum, vanadium and others in the industrial field.

J. A. Holladay has been elected a Vice-President of United States Vanadium Corporation and has assumed charge of this new Division. Production and sales will be under the direction of A. J. Gailey, Manager.

Mr. Holladay's headquarters will be at 30 E. 42nd St., New York. Mr. Gailey's headquarters address is Post Office Box 519, Niagara Falls, N. Y.

• SPONSORS RESEARCH FELLOWSHIP

The American Viscose Corporation is sponsoring a Rayon Launderability Research Fellowship at the American Institute of Laundering in order to develop complete data on the laundering characteristics of rayon men's shirts. It is hoped that it will be possible, through the application of facts determined by this research, to establish recommended procedures for the laundering of rayon shirts that can be adopted by the laundry industry.

Shirts that represent the basic constructions used in men's rayon shirts are being furnished for testing by the American Viscose Corporation. Using these, laundering tests are being conducted to determine the influence of laundering procedures on shrinkage, color retention, and wet and dry tensile strength. In addition, the fabrics will be evaluated generally in terms of hand, finish and appearance.

• EXPANDS DETROIT BRANCH OFFICE

Stein, Hall & Co., Inc., 285 Madison Ave., New York, manufacturers of starches, gums, dextrines and other materials and importers of burlap and other commodities, has expanded its Detroit branch office at 705 Stephenson Building, under the management of G. N. Streit, formerly associated with the Chicago office.

Mr. Streit's staff includes M. F. Hunt, covering Stein-Hall's general line; R. Swint, specializing in products for the food industry; E. B. Taylor, handling general adhesives and paper mill materials; and H. J. Jones, contacting manufacturers of corrugated board in the interests of the Stein-Hall Starch Process.

• JOINS JACQUES WOLF & COMPANY

Frank L. Fassnacht has recently become associated with Jacques Wolf & Company, of Passaic, N. J., manufacturers of chemical specialties for the textile and tanning industries. Mr. Fassnacht will make his headquarters in Boston and will call on the trade in Massachusetts, Vermont, New Hampshire and Maine; in the capacity of technician and demonstrator for the many specialties offered by Jacques Wolf & Company.

• ELECTED A VICE-PRESIDENT OF INTERCHEMICAL

At a special meeting of the Board of Directors of Interchemical Corporation, held on March 19, 1945, Dr. A. E. Gessler was elected a Vice-President of the Corporation.

After receiving a Ph.D. in Berlin, Dr. Gessler came to this country and joined G. Siegle Company. He left Siegle in 1919 to form the Ultro Chemical Corporation, which subsequently merged with Zinsser & Company, Dr. Gessler becoming Chief Chemist and member of the Board of Directors.

In 1934 Dr. Gessler was appointed Director of Research for the newly formed Research Laboratories of Interchemical Corporation.

• S.O.C.M.A. MEETING

In view of the postponement of the date of the Tariff Hearings to April 18th. the regular monthly luncheon meeting of the S.O.C.M.A. set for April 20th has been postponed to Thursday, May 10th, Commodore Hotel, New York, N. Y., Room A (Ballroom Floor) at 12:30 p.m.

• RECEIVES CITATIONS

Col. J. Ebert Butterworth, (AUS), G-5, Allied Force Headquarters, Mediterranean Theater of Operations received the following citations on March 30, 1945.

(1) The Deputy Military Secretary, Allied Force Headquarters, informs that His Majesty The King, has awarded the Officer of the Military Division of the Most Excellent Order of the British Empire to Colonel J. Ebert Butterworth, 0103853. . . (2) The Theater Commander has concurred in the acceptance of this award. . . (3) Colonel Butterworth may wear the appropriate ribbon of the award pending presentation of the insignia at a later date. . . By Command of General McNarney.

It is believed that Colonel Butterworth is the first American officer in the Mediterranean Theater to receive this award which is given in recognition of his work on the AMG Board in Italy.

Colonel Butterworth, Vice-President of H. W. Butterworth & Sons Company and a veteran of World War I, re-entered the U. S. Army on June 24, 1941, nearly six months before Pearl Harbor. He has been in service abroad since the beginning of the Mediterranean Campaign.

• JOINS TEXTILE ANILINE & CHEM. CO.

Edward B. Bell, sales and service representative of Calgon, Inc., in the New England textile field, has left the employ of R. L. Williams, Boston agency for Calgon, Inc., to become associated with the Textile Aniline & Chemical Co., Lawrence, Mass., of which Roland Derby is president, according to a recent announcement by Calgon, Inc.

Mr. Bell was the first one to introduce Calgon to the textile mills in this country, having joined the staff of Calgon, Inc., in 1933. He has specialized on the

sales and service of Calgon for the past 12 years.

After graduating from the Lowell Textile Institute in 1924, he was associated with the Malden Woolen Mills as a dyer, and later joined the staff of Calgon, Inc.

• NEW CYANAMID DEPARTMENT

The importance of synthetic resins in the field of textile finishing was again emphasized when American Cyanamid Company announced the formation of a new Department expressly to handle its products for this field. R. E. Sumner, who has been Department Manager of Dyestuffs for Calco Chemical Division, will head the new Textile Resin Department as Manager.

American Cyanamid Company, active in the production of many types of synthetic resins for crease proofing and general finishing in the cotton and rayon trade, developed methods for treating the many types of fabrics procured for the fighting forces by the United States Government. Among these was a process for treating Nylon and cotton nettings for use under tropical conditions wherein the coloring, the mildew proofing and water repellency, as well as fabric stability were accomplished in one application.

Several years ago alkylated melamine formaldehyde resin, developed by American Cyanamid Company's Stamford Laboratories, showed evidence of value in the textile finishing field. Investigation carried on under the impetus of the war showed that this resin was valuable for the shrinkage control of wool and wool blends. A procurement of 750,000 yards of wool sleeping bag lining material was treated with this resin for the Government, and found satisfactory in field trials according to the Philadelphia Quartermaster Corps.

Lanaset, the registered trademark under which this melamine resin compound is sold, has been given wide acceptance by the woolen trade in recent months, with the result that several garment manufacturers are planning to introduce Lanaset treated apparel with their fall lines.

The processing of wool and wool fabrics with Lanaset or other alkylated melamine formaldehyde resins is covered by U. S. re-issue patent 22,566 of American Cyanamid Company.

Other trademarked products in the process of development or awaiting termination of the war for introduction, are Permel 33 for crease and spot resistance; Lacet, a permanent finish for nettings; Aerotex 120, a semi-durable finish for imparting stiffness of hand and increasing body in cotton and rayons. Many other industrial finishing products such as warp sizings and moisture repellents are also in process of development.

The new Textile Resin Department will have its headquarters at the plant in Bound Brook, New Jersey, with branch offices in Charlotte, Chicago and Providence, as well as New York.

• JOINS BUTTERWORTH

Wallace Taylor has joined the organization of H. W. Butterworth & Sons Company, Philadelphia, as Sales Engineer. Mr. Taylor brings to this new connection an experience of thirty-five years in textile finishing. For twenty-two years, he was with Textile Finishing Machinery Company, Providence, R. I. (now a branch of Butterworth)—10 years as sales engineer; 12 years as sales manager. For three years he was associated with the late Horner Loring, establishing bleaching, printing and finishing plants owned and operated by United Merchants and Manufacturers Management Corporation. Immediately prior to joining Butterworth he was General Manager of Marshall & Williams Manufacturing Company. Mr. Taylor was educated in England and the United States, and is a graduate of Lowell Textile Institute. He will make his headquarters at the Butterworth branch plant in Providence, R. I.

Wallace Taylor

• CALCO APPOINTMENTS

Calco Chemical Division, American Cyanamid Co., Bound Brook, New Jersey, has announced the appointment of J. Pfister as manager of the dyestuff department and A. B. Clow as assistant manager.

• ONYX OIL ADDITIONS

L. Max McDaniel has joined the technical and sales force of the Chicago office, Onyx Oil & Chemical Co., 445 North Lake Shore Drive. He will cover the middlewest general textile field. Mr. McDaniel attended the Universty of Iowa and has had nearly 15 years experience in all types of dyeing and finishing.

Carl E. Bick has been appointed to the sales and technical department of the Chicago office and will cover the middlewest hosiery dyeing and finishing trade. He attended Lehigh University and for more than 20 years was superintendent of dyeing and finishing for the Real Silk Hosiery Company.

Melvin P. Rainville has joined the sales and technical service of the Providence, R. I. office, located at 511 Westminster Street. He will call on the textile and allied trades throughout northern New England. Mr. Rainville has been overseer of finishing for a number of New Zealand mills during the past 15 years.

• HATCH PRICE LIST

Hatch Textile Research, textile technologists at 25 East 26th Street, New York 10, N. Y., has recently issued a price list. It is stated that there are only a few minor changes made since the last list was issued in October, 1942. Next year will mark the 20th anniversary of this firm.

• ARMY-NAVY PURCHASING OFFICE

The War and Navy Departments announced recently that premises have been secured at 111 East 16th Street, New York City, New York, for the establishment of an Army-Navy Purchasing Office.

Agreement to open an office to purchase textiles, certain items of clothing and other items to be designated later was reached by the Secretary of the Navy, James V. Forrestal, and the Under Secretary of War, Robert P. Patterson.

Colonel Thomas W. Jones will be the commanding officer for the Army Quartermaster Corps, and Commander Marshall W. Tuthill will be the commanding officer for the Navy Bureau for Supplies and Accounts.

• CALCO BULLETIN

The technical paper, "Wool Dyeing: Effect of Variations in Wool," presented by Dr. R. H. Kienle, at the Annual Meeting of the American Association of Textile Chemists & Colorists, at Atlantic City, New Jersey, October 14, 1944 and prepared by Drs. Kienle, Royer and McCleary, of the Calco Chemical Division, American Cyanamid Company, Bound Brook, New Jersey, has been reprinted by that organization in their Technical Bulletin No. 762.

Copies of the bulletin may be obtained through your Calco representative or by addressing your request to the Advertising Department, Calco Chemical Division, American Cyanamid Company, Bound Brook, New Jersey.